PROCEEDINGS

OF THE

BOARD OF AGRICULTURE IN INDIA

HELD AT

PUSA

ON THE

21st February 1910, and following days

WITH APPENDICES

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
1910

PUSSA MEETING—FEBRUARY, 1910.

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No. C.-876, dated Pusa, the 9th March 1910.

From—J. MOLLISON, Esq., M.R.A.C., Inspector General of Agriculture in India,

To—The Secretary to the Government of India, Department of Revenue and Agriculture, Calcutta.

I have the honour to submit the Proceedings of the Sixth Meeting of the Board of Agriculture in India, held at Pusa on the 21st February, 1910, and subsequent days. These Proceedings have been recorded by Mr. C. M. Hutchinson, Imperial Agricultural Bacteriologist, who agreed to act as Secretary. The Proceedings have been approved by the Board.

Proceedings of the Sixth Annual Meeting of the Board of Agriculture in India, held at Pusa on the 21st February 1910, and succeeding days.

LIST OF MEMBERS.

1. J. MOLLISON, M.R.A.C., *Inspector General of Agriculture in India (President).*
2. C. M. HUTCHINSON, B.A., *Imperial Agricultural Bacteriologist (Secretary).*
3. B. COVENTRY, *Director, Agricultural Research Institute, and Principal of College, Pusa.*
4. J. W. LEATHER, Ph.D., F.I.C., F.C.S., *Imperial Agricultural Chemist, Pusa.*
5. E. J. BUTLER, M.B., F.L.S., *Imperial Mycologist, Pusa.*
6. H. M. LEFROY, M.A., F.E.S., F.Z.S., *Imperial Entomologist, Pusa.*
7. A. HOWARD, M.A., A.R.C.S., F.C.S., F.L.S., *Imperial Economic Botanist, Pusa.*
8. G. C. SHERRARD, B.A., *Assistant Agriculturist, Pusa.*
9. FRED NOËL-PATON, *Director General of Commercial Intelligence.*
10. I. H. BURKILL, M.A., *Reporter on Economic Products to the Government of India.*
11. THE HON'BLE MR. H. W. ORANGE, C.I.E., *Director General of Education in India.*
12. W. H. BUCHAN, M.A., I.C.S., *Offg. Director of Agriculture, Bengal.*
13. F. SMITH, B.Sc., F.H.A.S., *Deputy Director of Agriculture, Bengal.*
14. A. C. DOBBS, B.A., *Principal, Agricultural College, Bengal.*
15. THE HON'BLE MR. H. J. HOARE, I.C.S., *Director of Agriculture, United Provinces of Agra and Oudh.*
16. B. C. BURT, B.Sc., F.C.S., *Deputy Director of Agriculture, United Provinces of Agra and Oudh.*
17. H. M. LEAKE, M.A., F.L.S., *Economic Botanist, United Provinces of Agra and Oudh.*
18. A. E. PARR, M.A., B.Sc., Ph.D., M.S., *Deputy Director of Agriculture, United Provinces of Agra and Oudh.*
19. W. C. RENOUF, I.C.S., *Director of Agriculture, Punjab.*
20. S. MILLIGAN, M.A., B.Sc., *Deputy Director of Agriculture, Punjab.*
21. J. H. BARNES, B.Sc., A.I.C., F.C.S., R.I.P.H., *Agricultural Chemist and Principal of the Agricultural College, Punjab.*
22. G. F. KEATINGE, I.C.S., *Director of Agriculture, Bombay.*
23. H. H. MANN, D.Sc., *Agricultural Chemist and Principal, Agricultural College, Bombay.*
24. G. S. HENDERSON, N.D.A., N.D.D., *Deputy Director of Agriculture, Sindh.*

25. M. E. Couchman, I.C.S., *Director of Agriculture, Madras.*
26. W. H. Harrison, M.Sc., *Agricultural Chemist, Madras.*
27. R. W. B. C. Wood, B.A., *Principal, Agricultural College, Madras.*
28. P. Hemingway, I.C.S., *Director of Agriculture, Central Provinces.*
29. D. Clouston, M.A., B.Sc., *Deputy Director of Agriculture, Central Provinces (South Circle, Nagpur).*
30. G. Evans, B.A., *Deputy Director of Agriculture, Central Provinces (North Circle, Hoshangabad).*
31. F. J. Warth, M.Sc., *Agricultural Chemist, Burma.*
32. F. W. Strong, I.C.S., *Director of Agriculture, Eastern Bengal and Assam.*
33. Rai Bahadur B. C. Basu, M.R.A.C., *Deputy Director of Agriculture, Eastern Bengal and Assam.*
34. L. C. Sharma, M.R.A.C., P.A.S.I., *Bar.-at-Law, Director of Agriculture, Kashmir.*
35. M. A. Sitole, B.A., M.R.A.C., *Bar.-at-Law, Director of Agriculture and Industries, Baroda.*
36. L. C. Coleman, Ph.D., *Mycologist and Entomologist to the Government of Mysore.*

Visitors.

37. The Hon'ble Mr. R. W. Carlyle, C.I.E., I.C.S., *Secretary to the Government of India, Department of Revenue and Agriculture.*
38. A. G. Birt, B.Sc., *Supernumerary Agriculturist, Pusa.*
39. E. Holmes-Smith, B.Sc., *Supernumerary Botanist, Pusa.*
40. F. J. F. Shaw, A.R.C.S., B.Sc., *Supernumerary Mycologist, Pusa.*
41. E. J. Woodhouse, B.A., *Economic Botanist, Bengal.*
42. C. Somers-Taylor, B.A., *Agricultural Chemist, Bengal.*
43. H. E. Annett, B.Sc., *Agricultural Chemist, United Provinces.*
44. J. B. Knight, M.Sc., *Professor of Agriculture, Agricultural College, Poona.*
45. W. Burns, B.Sc., *Economic Botanist, Bombay Presidency, Poona.*
46. T. F. Main, B.Sc., *Deputy Director of Agriculture, Bombay Presidency, Poona.*
47. M. Lonsdale, N.D.A., N.D.D., *Agricultural Expert for Court of Wards, Madras.*
48. W. MacRae, M.A., B.Sc., *Mycologist, Madras.*
49. F. J. Plymen, A.C.G.I., *Agricultural Chemist, Central Provinces.*
50. A. A. Meggitt, B.Sc., *Agricultural Chemist, Eastern Bengal and Assam.*
51. G. P. Hector, M.A., B.Sc., *Economic Botanist, Eastern Bengal and Assam.*
52. R. S. Finlow, B.Sc., F.C.S., *Fibre Expert to the Government of Eastern Bengal and Assam.*
53. F. Booth-Tucker, *Commissioner, Salvation Army, Simla.*
54. M. L. Kulkarni, *Agricultural Inspector, S. D. Bombay.*
55. G. W. Hope, *Scientific Officer, Indian Tea Association.*
56. C. J. Bergtheil, *Scientific Officer, Behar Planters' Association.*
57. Mr. Wright, *Assistant, Messrs. Ewing & Co., Calcutta.*
58. W. Egerton, I.C.S., *Magistrate and Collector, Darbhanga.*
59. M. H. Arnott, M.I.C.E., *Superintending Engineer, Public Works Department, Bengal, Gandak Division.*

Programme of the Sixth Meeting of the Board of Agriculture in India, 1910.

SUBJECT I.—The Confirmation of the Proceedings of the last Meeting.

SUBJECT II.—The Programmes of Work of the Imperial Department of Agriculture for 1910-11.

SUBJECT III.—The Programmes of Work of the Provincial and Native States Departments of Agriculture for 1910-11.

SUBJECT IV.—The Most Economical use of the Manures that are available in India.

SUBJECT V.—The Reh Problem in India.

SUBJECT VI.—The Best Means of supplying Improved Agricultural Implements to Cultivators.

SUBJECT VII.—The Oil-pressing Industry in India and the Best Means of Extending it.

SUBJECT VIII.—Cattle-breeding and Value of Cattle Shows in India.

(A note by Major A. S. Trydell, I.C.V.D., Superintendent, Civil Veterinary Department, Sind, Baluchistan and Rajputana.)

SUBJECT IX.—*Co-operation between the Education and Agricultural* Departments with reference to the Improvement of the Preliminary Training of Boys likely ultimately to enter Agricultural Colleges or to be engaged in Agricultural Pursuits.

SUBJECT X.—The Best Means of Bringing the Results of Experimental Work in *Agriculture to the Notice of Cultivators.*

SUBJECT XI.—Agricultural Engineering particularly in regard to Well-boring and Well-irrigation. Progress made in Agricultural Engineering in the different Provinces and the Necessity for the Services of Agricultural Engineers.

SUBJECT XII.—The style in which the Programmes of the Provincial Agricultural Departments should be submitted to the Board. (Page 38 of the *Proceedings of the Board of Agriculture in India*, 1909.)

Appointment of Committees.

1. The President, after welcoming the members of the Board, referred to the wide scope of the subjects put down for discussion, which he proposed to deal with through Committees in the first instance, the reports of these Committees being submitted for consideration by the full Board during the latter half of the week. The President expressed his regret at the loss of Mr. Shearer to the Indian Agricultural Service, whom he characterised as an ardent worker and a thoroughly practical agriculturist and referred to the valuable services of Dr. Butler and Mr. Howlett as previous Secretaries of the Board. The President then laid before the Meeting his proposals for the constitution and terms of reference of the Committees to consider and report on the subjects before the Board.

2. The Committees were constituted as follows :—

(*A*) To consider and report on—

(i) The Programmes of work of the Imperial Department of Agriculture. (Subject II.)

(ii) The style in which the Programmes of the Provincial Departments of Agriculture should be submitted to the Board. (Subject XII.)

Committee.—Mr. Couchman (Chairman), Messrs. Strong and Coventry, Drs. Leather and Butler, Messrs. Milligan, Clouston and Barnes, Dr. Parr, Messrs. Main and Meggitt and Dr. Coleman.

Terms of reference.—

(*a*) In regard to subject II to examine how far the programmes meet the requirements of the Provinces and of the different branches of the Pusa Institute.

(*b*) In regard to subject XII—

(i) to consider the best methods for uniformity in the drawing up of programmes;

(ii) to consider whether the programmes could be so framed as to distinguish between (1) work in progress and (2) new work undertaken for the first time.

(*B*) To consider and report on the Programmes of work of the Provincial and Native States Departments of Agriculture. (Subject III.)

Committee.—Mr. Keatinge (Chairman), Messrs. Mollison, Lefroy, Burkill, Howard, Leake, Smith, Wood, Warth, Evans, Henderson, Basu and Sitole.

Terms of reference.—

(i) to examine how far the programmes meet the requirements of the Imperial Experts and whether they require any improvement to meet the special requirements of different Provinces;

(ii) to consider, in regard to correlation of work, the suggestions made by Mr. Burkill in his letter dated the 15th February, 1909 (Appendix B., page 49), and

(iii) any other considerations in regard to the correlation of work.

(*C*) To consider and report on the Reh Problem. (Subject V.)

Committee.—Mr. Renouf (Chairman), Drs. Leather and Mann, Messrs. Milligan, Barnes, Henderson, Harrison, Burt and Annett.

Terms of reference.—

(i) To consider the reports submitted by different Provinces.

(ii) To examine the results of previous work and to recommend lines of work for the immediate future.

(*D*) To consider and report on—

(i) The best means of supplying improved agricultural implements to cultivators. (Subject VI.)

(ii) Agricultural engineering, particularly in regard to well-boring and well-irrigation. Progress made in agricultural engineering in the different Provinces and the necessity for the services of Agricultural Engineers. (Subject XI.)

Committee.—Mr. Noël-Paton (Chairman), the Hon'ble Mr. Hoare, Messrs. Buchan, Coventry, Arnott, Main, Smith and Knight, Dr. Parr, Messrs. Plymen, Dobbs, Keatinge and Burt.

Terms of reference.—In regard to subject XI to report as to the progress made in well-irrigation and well-boring in the different Provinces and on the advisability of deputing an experienced Engineer to advise the Provincial Departments of Agriculture in the matter.

(*E*) To consider and report on the best means of bringing the results of experimental work in Agriculture to the notice of cultivators. (Subject X.)

Committee.—Dr. Mann (Chairman), Messrs. Mollison, Renouf, Couchman, Hutchinson, Clouston, Smith, Finlow, Burt and Kulkarni.

Terms of reference.—To amplify as far as possible the report already published.

(*F*) To consider and report on—

(i) The most economical use of the manures that are available in India. (Subject IV.)

(ii) The oil-pressing industry in India and the best means of extending it. (Subject VII.)

Committee.—Mr. Coventry (Chairman), Messrs. Noël-Paton, Burkill, Evans, Wood, Harrison, Hutchinson, Knight, Warth and Basu, Dr. Coleman and Mr. Lonsdale.

(*G*) To consider and report on the co-operation between the Education and Agricultural Departments with reference to (*a*) the improvement of the preliminary training of boys likely ultimately to enter Agricultural Colleges or to be engaged in agricultural pursuits and (*b*) their scientific and practical training at Pusa and Provincial Colleges. (Subject IX.)

Committee.—The Hon'ble Mr. Hoare (Chairman), the Hon'ble Mr. Orange, Drs. Butler and Mann, Messrs. Strong, Barnes, Main, Clouston and Wood, Dr. Parr and Mr. Dobbs.

Terms of reference.—To consider chiefly the letter from the Government of India, Department of Revenue and Agriculture, No. 1240—210-1, dated the 29th November 1909 (Appendix F, page 66).

SUBJECT I.—The Confirmation of the Proceedings of the last Meeting.

The minutes of the Meeting held at Nagpur on February 15th, 1909, and following days were confirmed.

SUBJECT II.—The Programmes of Work of the Imperial Department of Agriculture for 1910-11.

The report of Committee (A) (Appendix A, page 47) on this subject was considered.

I.—Programme of the Director, Agricultural Research Institute and Principal of College, Pusa.

(B Coventry.)

The scientific work of the Institute for the coming year is indicated under the programmes of the different sections.

The Prospectus of the Institute and College, as revised by the Board of Agriculture, 1909, and finally approved by the Government of India, has been published, and the courses given in the several sections will be on the lines indicated therein.

For the benefit of *bonâ fide* agriculturists and the subordinate staff of the Agricultural Departments, special short courses of a simple and practical nature have been instituted and instruction in these subjects will be continued.

The Board accepts the programme of the Director, Agricultural Research Institute, Pusa.

II.—Agricultural Chemistry.

(J. Walter Leather, Ph.D., F.I.C., F.C.S.)

1. The work on the availability of plant food in soils will be continued, the immediate aim being the more correct ascertainment of the composition of the aqueous solution in the soil. Included in this section of investigation are naturally

the amounts of nitrate in soils and temperatures. It is intended to co-operate, if possible, in relation to this subject, with the Imperial Bacteriologist.

2. The investigation on soil moistu re and water requirements of plants is being continued on lines which have been sufficiently indicated in the memoirs.

3. A joint investigation with Mr. Burt, Deputy Director of Agriculture, United Provinces, is being conducted into the causes of infertility in a tract of land in the Mainpuri District.

4. The effect of soil and manure on the composition of crops is a branch of study which is engaging the attention of a number of investigators and is one on which I have already obtained some information. It will be developed at Pusa during the coming year.

5. Two points in relation to the Indian saltpetre manufacture, in respect of which it seems possible that an improvement can be suggested, will be investigated.

6. *Education.*—This requires no special comment; it will be conducted according to the lines laid down.

The Board accepts the programme of the Imperial Agricultural Chemist.

III.—Economic Botany.

(A. Howard, M.A., A.R.C.S., F.C.S., F.L.S.)

1. *Training.*—The training of advanced students in this section will be continued on the lines laid down in the prospectus of the Institute. The course on fruit-growing will be given as usual in the cold weather.

2. *Plant breeding and plant improvement.*—During 1910, the following crops will be studied:—wheat, tobacco, barley, oilseeds and fibre plants.

(*a*) *Wheat.*—The botanical survey of the wheats of Baluchistan will be completed. The production of improved varieties by selection and hybridization will be continued. The co-operative experiments on the effect of environment on the milling and baking qualities of Indian wheats, which are being conducted in collaboration with Mr. H. M. Leake, Economic Botanist to the United Provinces, and of which the earlier results are now in course of publication are being continued on an extended basis. The above experiments include the effect of weathering on the quality of the wheat crop and the Imperial Bacteriologist has agreed to undertake the study of the Bacteriological aspect of this subject.

(*b*) *Tobacco.*—The production of new varieties by selection and hybridization will be continued as well as the testing and curing of the varieties already isolated. The investigations on the influence of environment on the stability of the type and on the quality, will be continued.

(*c*) *Oil-seeds.*—The study of the oil-seeds of India will be continued on similar lines to those adopted in the investigations on wheat.

(*d*) *Fibres.*—The isolation and testing of pure races of the fibre plants of India will be continued.

(*e*) *Fruit.*—The fruit experiments will be continued on the lines laid down in the First Fruit Report.

(*f*) *Minor Investigations.*—The study of the varieties of cassava will be completed and the investigation on the inheritance of sex in *Ganja* continued.

The Board accepts the programme of the Imperial Economic Botanist.

IV.—Mycology.

(E. J. Butler, M. B., F. L. S.)

1. *Research and Experimental work.*—Owing to the opportunity for co-operation afforded by the appointment to Pusa of the Imperial Bacteriologist, it is proposed to resume the work on soil fungi which was temporarily abandoned two years ago.

The work on the wilt diseases of crops, especially of indigo, and cowpea and if opportunity occurs, of cotton and gram will be continued.

The investigation of sugar-cane diseases is being continued and the new results regarding red-rot will be published. The Supernumerary Mycologist is investigating the life history of sugar-cane smut.

Assistance will be given in the campaign against the bud-rot disease of palmyra palms in the Godavari. An account of the parasite and a review of the work undertaken to prevent its spread will be published.

It is proposed to publish a preliminary account of the soft-rot disease of ginger based on the work of the last two years.

The study of some anthracnoses of *leguminous crops, especially* of *val* (*Dolichos*) and cowpea, will be begun.

2. *Training.*—The training of students in Mycology will be continued and the advanced course of Mycology will be given to those already in training. Assistance will be given to Provincial Colleges in providing notes and material for Mycological instructions.

3. The collection and identification of Indian parasitic fungi will be continued. If possible a complete list of the ascomycetes in the Pusa Herbarium will be published and the text of the book of Indian Plant Diseases finished.

Mr. Hector asked Dr. Butler whether he proposed to keep in view the Khasia Hills orange disease. Dr. Butler replied that it would be *impossible to do so at* a distance and would involve investigation on the spot. He, however, stated that a simple remedy was known which consisted in budding on pomeloes or sour limes.

The Board accepts the programme of the Imperial Mycologist.

V.—Entomology.

(H. M. Lefroy, M. A., F. E. S., F. Z. S.)

1. *Research and Experimental Work.*—The work of the past year in studying and advising on crop pests will be continued. Assistance will be given, where desired, in directing the work of Provincial Assistants and in coping with any outbreaks of pests that may occur. So far as possible, all specimens of insects sent in will be identified and work in connection with the reference collection of insects of the plains will be continued. The issue of coloured plates of injurious and beneficial insects will be continued. Enquiries in progress on insecticides and spraying machines, fumigation, the danger of the importation of injurious insects and the value of parasites as checks on crop pests will be carried on as time permits. The staff of the Second Imperial Entomologist will continue work in progress on mosquitos, biting flies and fruit flies. The cultivation of lac at Pusa will be continued and so far as possible assistance will be given to those wishing to start cultivation in agricultural areas. Eri silk cultivation will be continued as the basis of a possible cottage industry in several parts of India and assistance will be given so far as possible in starting the industry in new localities. The cultivation of mulberry silk will be continued chiefly with a view to giving advice to those who require it and to testing the possibilities of this industry in new localities. Tassar silk rearing will not be continued.

2. *Training.*—It is uncertain if any students will present themselves for the course of advanced entomology. If they do, this course will continue as before. Short courses in eri silk and lac cultivation will be given if required as also a course in sericulture. If possible, instruction in dealing with insects injurious to live-stock will be given as part of the course in cattle-breeding.

3. *Publications.*—A revision of Indian Insect Pests in Bengali is being published; if time permits, the full revision of the text of Indian Insect Pests will be taken up.

The Board accepts the programme of the Imperial Entomologist.

VI.—Agricultural Bacteriology.

(C. M. Hutchinson, B.A.)

The Biological aspects of tillage in Indian soils.—This will involve investigations extending over a prolonged period, the basis of which would include a general investigation of the bacterial content of Indian soils.

Concurrently with this general investigation special observations will be made with the intention of determining the biological factors underlying certain problems of agricultural interest such as those connected with the custom of embanking wheat lands. They will also include enquiries into :—

(1) The biological aspects of the availability of plant food in soils.

(2) The *biological factors concerned in the decomposition of organic matter in Indian cultivated soils.*

(3) *Biological aspects of :—*

(*a*) Green manuring in India.

(*b*) " Weathering " of soils.

(*c*) Effect of ploughing land when too wet, before sowing.

No. (1) will be carried out in collaboration with the Imperial Agricultural Chemist, No. (2) in collaboration with the Imperial Mycologist and No. (3) in collaboration with the Imperial Economic Botanist.

0. The Board accepts the programme of the Imperial Bacteriologist.

VII.—Agriculture.

(B. Coventry.)

1. *Permanent Experiments.*—The permanent manurial and rotation experiments and the pasture experiments will be continued.

2. *Extension of Botanical Work.*—The growth of selected varieties of wheat will be taken up in extension of the work now being done by the Imperial Economic Botanist. This work will be carried on in consultation with and under the botanical surveillance of the Imperial Economic Botanist.

3. *Cattle-breeding.*—The local herd has been transferred to the Bengal Agricultural Department and the Montgomery herd will now be considerably increased. Improvements of this breed by selection based principally on milk tests will be the chief object in view. It is also intended to start a dairy.

4. *Sheep.*—The crossing of local and Bikanir ewes with Dumba rams will be continued.

5. *Poultry.*—Poultry breeding and distribution will be continued.

6. *Training.*—Courses in the practice of agriculture will be given as heretofore.

The Board accepts the programme of the Agricultural Section of the Pusa Research Institute.

VIII.—Cotton.

Programme of the Imperial Cotton Specialist.

(G. A. Gammie, F. L. S.)

1. To visit and advise on points regarding Cotton and its cultivation whenever requested to do so by Provincial Departments of Agriculture or even by individual cultivators.

2. By special invitation of the Department of Agriculture, Central Provinces, to make detailed investigations throughout the whole of the cotton tracts of that Province in co-operation with the Deputy Directors of Agriculture ; a continuation of this research would probably have to be carried into Khandesh and Bengal ; also to investigate into the distribution of superior varieties in the rich Cotton tracts of the Nizam's Dominions especially those which lie along the Godavary river.

3. As Bourbon and *Buri* Cottons appear to be two superior varieties most suitable for what are at present non-cotton producing tracts, namely, those with a sandy or red soil or with a rainfall heavier than can be borne by indigenous varieties, it is proposed to carry out experiments with these, on lands furnished by the owners, in parts of Rajputana, near the Western Ghats and perhaps Mysore. I understand that the officers of the Madras Agricultural Department are to undertake investigations into the Bourbon cultivation in the red soils of their Presidency.

4. The re-establishment of superior varieties in Kathiawar and other parts which substituted inferior drought resisting Cottons during the famine year of 1899-1900.

The Board accepts the programme of the Imperial Cotton Specialist with the modification suggested by Committee A.

SUBJECT III.—The Programmes of Work of the Provincial and Native States Departments of Agriculture.

The report of Committee (B) was placed before the Board, individual consideration being given to each Programme in turn (Appendix B, page 48).

1.—BENGAL.

I.—Programme of Deputy Director.

(F. Smith, B. Sc., F.H.A.S.)

There are three Agricultural stations, Bankipore, Cuttack and Chinsura, and two zamindari farms, Burdwan and Dumraon, under the Deputy Director. The Agricultural station at Sabour is under the Principal of the College; particulars regarding physical and climatic conditions are given in the statement below:—

Serial No.	Name of Station.	Situation.		Tract represented.	Area in acres.	Type of soils.	Date when established.	Height above sea level.	Average rainfall in inches.	Temperature.	
		North Latitude.	East Longitude.							Maximum.	Minimum.
								Feet.			
1	Burdwan	23°70′	88°00′	Burdwan	31	Sandy alluvium	1885	99	57·54	89°	70°
2	Dumraon (Shahabad).	25°30′	84°00′	Shahabad	30	Sandy loam	1895	239	41·13	86°	68°
3	Bankipore	25°37′	85°14′	Patna	210	Heavy clay	1906	183	44·54	88°	69°
4	Sabour (Bhagalpur).	25°12′	87°1′	Bhagalpur	324	Sandy	1906	160	49·35	87°	68°
5	Cuttack	20°29′	85°54′	Orissa Delta	60	Sandy	1904	80	60·35	90°	73°
6	Chinsura	22°53′	88°27′	Lower Bengal Delta.	210	Clay	1908	38	..	..	..

In addition the Deputy Director has charge of the Chaibassa Tassar Silk Farm, and he supervises the work of a private demonstration farm at Kalimpong, which the department subsidises.

The Deputy Director is carrying out the following lines of work at these stations:—

Paddy.—This crop is under experiment at all stations except Chaibassa, and is also being grown specially for seed distribution. Manurial and variety experiments are in progress also; experiment concerning the number of seedlings in transplantation, the efficiency of different kinds of ploughs in the preparation of seed beds is being tested. The efficient seed rate per acre for broadcasting is being tested at Burdwan, Chinsura and Cuttack. The results of different methods of irrigation are being observed at Cuttack and Burdwan, and other hydraulic experiments are carried on at Cuttack, Bankipore and Chinsura.

Jute.—Work on jute is being carried on at Burdwan, Cuttack and Chinsura. The work at Chinsura is partly for seed distribution, but manurial experiments are also conducted there. At Burdwan and Cuttack the following experiments at present being carried on, will be continued:—

1. Manurial.
2. Cutting at different stages.
3. Variety.
4. Spacing.
5. Dril *versus* Broadcast sowing.
6. Rotation experiment with paddy.
7. Rotation experiment with potatoes.

Balers' valuation of fibres obtained from different kinds of experiments will be obtained.

Sugarcane.—At Burdwan, manurial, planting, rotation and variety experiments will be continued. Variety experiments will be continued at Cuttack, Burdwan, Bankipore and Chinsura.

Other crops.—Manurial and variety experiments on potatoes at Burdwan and Cuttack will be continued and similar experiments commenced at Chinsura. Variety experiments with mustard will be continued at Dumraon. Maize, wheat and *juar* manurial experiments will be continued at Bankipore, where gram, mustard and barley are also under observation. These crops are also grown for seed supply. The small experiments with buri kapas at Chaibassa will be continued. Groundnut and turmeric experiments will be continued at Cuttack. *Dhaincha* will be grown for seed supply at Chinsura. The manurial and variety experiments with wheat will be continued at Dumraon where oats will be grown for seed supply.

Tassar.—The rearing of cocoons will be continued at Chaibassa and the cultivation of *asan* and *arjun* trees will be pushed on. The following lines of work will be continued :—

(1) Rearing of wild mooga cocoons for distribution of the ampathia crop of the mooga cocoons in 1910 and for producing *jata daba* crop for distribution in 1911.

(2) Comparison of wild mooga, *jata daba* and *daba*.

(3) Comparison of mooga and laryas.

(4) Care and cultivation of young *asan* and *arjun* trees.

Sericulture.—Three more nurseries will be opened and the work of distributing pure seed will be continued. Training in sericulture will be given to rearers' sons.

II.—Programme of Principal.

(A. C. Dobbs, B.A.)

College.—It is hoped that the College will be opened in November 1910.

Sabour Farm.—The laying out and testing of the Farm as outlined in last year's programme will be continued. It is intended to undertake experiments designed to ascertain the cost and value of pumping water from wells by means of steam and oil engines.

Tour.—The irrigation of crops will be observed on tour as far as time allows.

III.—Programme of Economic Botanist.

(E. J. Woodhouse, B.A.)

1. In consequence of the opening of the College in November 1910, the time of the Economic Botanist will be again occupied to a considerable extent with the laying out of the Botanic garden and College grounds, and also with the supervision of the Botanical fittings of the College. The collection of teaching materials will also be continued.

2. The work of arranging exhibits, illustrating the principal economic crops of the province and the recommendations of the Department will be continued.

3. On the scientific side, the chief work of the past year has been the making of a preliminary survey of the field crops of the province in order to gain information on these crops and to decide in which direction work is likely to prove most valuable. This work will be continued. As a result of this survey more detailed work on the following crops, cucurbitaceæ, leguminosæ, setaria italica, and illucine coracana, is in progress. The classification of the varieties of sugarcane in co-operation with the Agricultural Chemist is still in hand; and some preliminary work on mangoes has been undertaken.

IV.—Programme of Agricultural Chemist.

C. Somers-Taylor, B.A.

During the early part of next year the Chemist will supervise the fitting up of the College laboratory.

The work of classifying the different types of sugarcane in Bengal is still being followed in co-operation with the Economic Botanist. The experiments on chemical selection of the canes are also being continued. Some attempts were made last year to start a study of the nitrifying power of different typical Bengal soils, but owing to the difficulty experienced in the present temporary state of the laboratory, it will be impossible to continue this work until better facilities are obtained. It is hoped that a commencement may soon be made in a properly equipped laboratory.

Mr. Smith explained that the experiments on paddy were designed with special reference to local conditions and in the light of previous experience, and in reply to Mr. Couchman, stated that other experimental work was not allowed to interfere with investigations dealing with paddy, the most important crop grown in Bengal.

At the suggestion of the President the Board agreed that the tabular statements in the Bengal Programme should be deleted.

Mr. Lefroy gave his reasons for recommending the discontinuance of the experiments on Tussar at Chaibassa (*vide* Appendix B, page 48).

The Board accepts the Programme of Bengal with the modifications suggested in the report of Committee (B) (Appendix B, page 48.)

2.—UNITED PROVINCES OF AGRA AND OUDH.

Programme of the work of Department of Agriculture.

(The Hon'ble Mr. H. J. Hoare, I.C.S., Director of Agriculture.)

Four agricultural stations are in existence. It was intended to organise two more during the past year but this has been impossible owing to financial pressure. These stations serve as local centres of the practical work of the department—demonstrations, advice and assistance, and supply of seed and implements: an experiment farm is attached to each, but the importance of the experimental work differs widely from station to station.

At Cawnpore the experiments which are in Ganges-Jumna doab soils still relate mainly to fundamental questions such as the gain and loss of nitrogen and the behaviour of water in soils. At Orai the central problem is to increase the diversity of cropping in the four classes of Bundelkhand black soil. Aligarh is concerned mainly with the improvement of cotton; while at Partabgarh sugarcane will be the principal subject under inquiry.

A few sub-stations exist for the study of special problems, at present the barren and alkaline lands and ravines. The chief lines of experimental work may be stated as follows:—

Cotton.

The Economic Botanist will continue his study of the genus gossypium; determination of the varietal characters and study of their inheritance. The Deputy Director at Cawnpore will continue the selection of Indian cottons. The Deputy Director at Aligarh will experiment with indigenous cottons and will probably continue the attempt to establish American cotton on a commercial scale.

Wheat.

The Economic Botanist will continue the classification of the wheats of the province based upon observation of the growing plant, and his co-operative experiments with Mr. Howard on the milling and baking qualities of Indian wheats will be extended.

The Deputy Director, Cawnpore, will continue to test pure Indian types of wheat on a field scale at Cawnpore, and at Orai will carry on his search for the types of wheat best suited to Bundelkhand conditions with especial regard to power of resistance to rust.

Sugarcane.

The work in connection with sugarcane is given in the programmes of the Agricultural Chemist and the Assistant Director, Partabgarh, below.

The deep and shallow tillage experiments at Cawnpore are now discontinued as they have yielded definite results.

Tillage.

A note on Entomological work is appended to the programme of the Deputy Director, Cawnpore.

Entomological work.

The workshops and power installations have been under the superintendence of an Agricultural Engineer. The past year has witnessed a distinct advance in the type of hand and bullock power pumps. Further attempts will be made to popularise these and also power pumps. Well-boring operations promise to be still further extended.

Irrigation.

Work continues as usual at the Agricultural College. The new building will be opened in the coming year.

Agricultural College.

The issue of the vernacular Agricultural Journal will continue, and leaflets will be issued as occasion arises.

Publications.

A poultry breeding and rearing farm has been started at Haldwani under the joint ownership of Government and Colonel Ward, an expert. Arrangements are being made for the residence and training of apprentices to this industry.

Poultry breeding.

The horticultural station in the Kumaon hills designed to promote the development of fruit and vegetable growing will be continued. The departmental horticultural stations at Saharanpur and Lucknow will be devoted to horticultural education and demonstration chiefly and to the introduction of new species and varieties of economic value.

Horticulture.

The demand for the simpler forms of implements continues to grow; the extension of village centres of distribution will be limited only by financial considerations.

Implements.

A new departure is the propagation of pure selected Muzaffarnagar wheat at Cawnpore on a scale suitable for distribution work.

Seed.

I give below the detailed programmes of the Economic Botanist, the Agricultural Chemist, the Assistant Director, Partabgarh, and the Deputy Directors, Cawnpore and Aligarh.

I.—Programme of the Economic Botanist.

(H. M. Leake, M.A., F.L.S.)

(1) The study of the Genus Gossypium will be continued on the lines laid down in last year's programme, *i.e.*, the determination of the varietal characters and study of their inheritance.

(2) The classification of the provincial wheats will be continued on the lines laid down in last year's programme.

(3) The co-operative experiments on the effect of environment on the milling and baking qualities of Indian wheats which are being conducted in collaboration with Mr. A. Howard, Imperial Economic Botanist, and of which the earlier results are now in course of publication are being continued on an extended basis.

(4) The examination into the forms, and distribution of Agave within the province will be continued.

(5) Attempts to profitably establish lac on the Dhak of Usar land are in progress.

(6) The supervision of the biological side of the college continues.

II.—Programme of the Agricultural Chemist.

(H. E. Annett, B. Sc.)

It is expected that the supervision of the chemical side of the college will take up a large portion of the time of the Agricultural Chemist. The new building will,

it is hoped, be completed and the office will have to be transferred from its present temporary buildings.

For the first year in the new buildings, especial attention will be paid to the teaching, a good deal of which will be carried out by the Agricultural Chemist personally.

The investigations being carried out on sugarcane will be continued and these chiefly comprise :—

(1) The examination of important local varieties of cane ;

(2) a determination of some of the factors that influence the composition of the juice, particular attention being paid to the influence of the number of stools per acre ; and

(3) an examination of the composition of sugars as actually sold in the bazars.

III.—Programme of the Assistant Director of Agriculture.

(S. M. Hadi, Khan Bahadur, M.R.A.C.)

Sugarcane.—The trial of local varieties will continue. Several varieties of Mauritius cane and of *Paunda* imported from the Samalkota farm (Madras) have been tested. Those that have grown satisfactorily at the farm will be planted again and seed canes of such varieties will be issued to private agriculturalists who are desirous of trying them.

Other crops.—A new variety of *bajra* (Pennisitum typhoidum) imported from Jaipur has been found to be superior to the local kinds and its cultivation is being extended at the Partabgarh Farm.

Manures.—The trial of Ammonium Sulphate on sugarcane will continue. It has so far given promising results.

Barren land.—The trial of gypsum for reclamation of alkaline lands (*Usar*) so as to render them fit for production of food crops has given highly satisfactory results at Amethi but the cost of the manure is prohibitive at present for the purposes just mentioned. But for growing trees on Usar lands with the application of the manure the cost of the latter is not unreasonable under the existing circumstances. The effect of the manure on Shisham and Mahua which is very marked will continue to be watched and more trees will be planted with the manure.

The experiment in ravines will be kept up on the lines mentioned in the 1908 programme.

Implements.—More local centres for sale of improved implements will be organised.

Seed.—Attempts to organise co-operative seed societies very few of which have so far been organised will continue. The business at seed depôts has been constantly increasing and a new depôt at Akbarpur, Oudh and Rohilkhand Railway, has been added to the list quite recently—besides the one at Jaunpur which originated over two years ago.

Demonstrations.—The sugar demonstrations are being given on a large scale with the result that a considerable number of sugar factories on our lines have been established already in the United Provinces and in some of the Native States and Assam. Next year (1910-11) the demonstrations will be confined to Allahabad where the Assistant Director will give them at the exhibition and he will not have the time to organise such demonstrations elsewhere.

Insect pests.—Practical measures will be taken for combating the grass-hopper (*Hieroglyphus* Furcifer) in the district of Azamgarh where the pest has played great havoc during the last three years. They were taken last year on a small scale and will be carried out on a larger scale and more vigorously in the next season.

IV.—Programme of the Deputy Director of Agriculture, Central Circle.

(B. C. Burt, B. Sc., F.C.S.)

Permanent experiments.—(Cawnpore Farm). These include the permanent manurial experiments, rotation experiments and experiments to determine the amount of irrigation water required by different crops.

Other manurial experiments.—At Cawnpore Farm the trial of artificial manures on cotton, the trial of nitrate of lime and cyanamide on wheat, sugarcane and poppy and of various refuse manures, *viz.*, cotton refuse from the mills and sugar factory refuse (filter press cake) on potatoes and wheat will be continued.

The comparison of *neem* cake, castor cake and poudrette as manures for potatoes is discontinued having yielded definite results and the residual effects of these manures are now under study.

At Orai Farm.—The comparative effect of poudrette now locally available and of farm yard manure on the four soils represented is under study.

Tillage.—The deep and shallow tillage experiment at Cawnpore having yielded definite results is now discontinued and the plots are now being utilised for an investigation into the value of stubble ploughing.

Tillage experiments at Orai both as regards the general cultivation of the four types of Bundelkhand soil and the elimination of *Kans* will be continued.

Cotton.—During the ensuing season certain pure Indian cottons received from the Economic Botanist will be tried on a field scale. The attempt to select fuzzless American cotton has been dropped as unlikely to lead to any results of practical value. The growing of American cotton for seed supply and experiments with different methods of sowing will be continued.

Wheat.—Pure selected Muzaffarnagar wheat is being propagated at Cawnpore for distribution. Several pure Indian types are under trial on a field scale at Cawnpore. A number of wheats are grown at the Orai Farm to test their suitability to Bundelkhand conditions and for selection of pure types. Wheat work is carried on in conjunction with the Economic Botanist at these farms.

Arhar.—The comparison of early and late ripening varieties will be continued at Cawnpore, and extended to the Orai Farm.

Ground Nuts.—The comparison of different varieties for out-turn and suitability will be continued at both Cawnpore and Orai. Comparison of different methods of sowing will be started during the current year as this crop appears to be becoming popular.

Juar.—The study of Bundelkhand juars at Orai Farm will be continued.

Other crops under investigation at Cawnpore and Orai include Cassia auriculata (as a tanning material), Prosopis Juliflora (as a fodder plant for waste land), cassava, spineless cactus, agaves (for waste land) and date palms; the last two at Orai only.

Soil moisture.—The soil moisture experiment in conjunction with the Imperial Agricultural Chemist at Cawnpore and Orai will be continued.

Barren land.—The experiments on tree growing at the Juhi sub-station (non-alkaline Usar) will be continued as will the experiments on the growing of lac on Dhak (Butea Frondosa).

Study of Alkaline soils.—At the request of the Irrigation Department the study of a water logged area of canal irrigated land in a fertile tract where alkali is increasing has been taken up in conjunction with an assistant lent by the Imperial Agricultural Chemist. The present investigation includes the study of the nature and distribution of the alkaline salts, their variation laterally and vertically and with season, and the investigation of the sub-soil strata. The investigation includes a study of the conditions causing the waterlogging.

Implement.—During the past year the number of village sub-centres in this Circle for the supply of agricultural implements has increased to ten. A number of other applications have been received and this work will be extended during the year so far as consideration of staff and finance allow. In addition to these a large business is done by the Cawnpore and Orai implements depôts.

Seed supply from Cawnpore is mostly confined to wheat and cotton and maize for cash payment. Ground nut seed is becoming however in considerable demand. The Orai Farm is this year being equipped with a seed store for supplying wheat seed on a larger scale to certain parts of Bundelkhand.

Demonstrations.—No special demonstration farms exist in the circle although the Orai Farm serves that purpose to a moderate extent. Amongst general de-

monstrations may be mentioned those for water lifts and agricultural implements given occasionally at village sub-centres. No other generally organised demonstrations have been taken up as it is found that the time of the present staff is fully occupied in visiting different zamindars who ask the department's advice and help in introducing improvements in their villages. Demonstrations are however given at all agricultural shows and district exhibitions.

Entomological work.—The Entomological Assistant's time will be partly devoted to a trial of eri silk and the training of rearers. The greater portion of his time will, however, be taken up with field work more especially in the Eastern Circle with reference to the hopper *Hieroglyphus furcifer*, which has recently become a major pest of sugarcane.

V.—Programme of the Deputy Director of Agriculture, Western Circle, Aligarh.

(A. E. Parr, B. Sc., Ph. D., M.A., M.S.)

The work on American and country cotton will be continued on the lines previously laid down.

Variety tests of sugarcane will be continued.

Manurial experiments with cotton cake are being carried on.

Usar reclamation experiments are being continued.

Efforts are being made to establish the growth and sale of American cotton in Aligarh on a commercial footing.

The Board accepts the programme of the United Provinces.

3.—PUNJAB.

I.—Programme of the Deputy Director of Agriculture.

(S. Milligan, M.A., B.Sc.)

1. *American Cotton Seed.—Distribution.*—This will be continued, confined mainly to the Canal Colonies. An increased area has been grown in the Lyallpur District this year. The success of the enterprise will depend largely on the selection work at the Agricultural Station and the overcoming of the marketing difficulties.

2. *Harvesting Machinery.*—The latest pattern of reaping machine has given satisfactory results and will probably be adopted as a standard pattern for a few years to come. Fourty-four of these machines were sold in the Province last year and one hundred and thirty more are being imported. The selling and distribution are being carried out by an importing Firm. The Department is confining its activities to practical instructions. A new type of winnower is under construction.

3. *Tillage implements.*—(*a*) A plough suitable for canal lands has been adopted after extended trials and is meeting a ready sale at present.

(*b*) The Spring-toothed harrows promise to be useful and a new design has been adopted as suitable to local requirements.

4. Monthly *zemindari* classes of practical instruction in working implements, etc., have been started and will be extended if the demand for this sort of instruction continues.

5. The question of advising Court of Wards estates has been taken up and estate reclamation of land will be attempted at Jalalabad.

6. An attempt will be made to extend the working exhibitions of implements at Cattle Fairs.

7. The progress of the *reh* investigations will depend on the amount of time at the disposal of the Agricultural Chemist.

8. The fodder scarcity investigation will require to be held in abeyance for another year.

9. The site for the second Agricultural Station has been acquired and the laying out of the land for experimental purposes will be pushed on as rapidly as possible.

10. The organisation of a staff of well-borers.

11. Other work will consist in the designing of new agricultural implements, the collection of implements and machines for the Lahore Exhibition, arranging for working exhibitions there, and general advice to correspondents and visitors.

II.—Programme of the Principal and Agricultural Chemist.

(J. H. Barnes, B.Sc., A.I.C., F.C.S., R.I.P.H.)

The College.—The general educational work of the College will be carried on in accordance with the published syllabus. A considerable amount of work still remains to be done in the laying out of the estate; this latter will probably occupy the whole year.

Chemical investigation.—The following investigations will be undertaken as far as time permits after dealing with the educational work:—

(1) Continuation of the investigation of the composition of the alkali lands of the Province combined with reclamation experiments in the field.

(2) In connection with the above problem, an experimental investigation of the type and quantity of salts absorbed by plants, and the limiting value of salinity for the germination of the more important crops.

(3) The manufacture of crude sodium carbonate from salt bush.

(4) Analysis of canal silts with reference to their effect on canal-irrigated areas.

III.—Programme of the Professor of Agriculture.

(W. Roberts, B.Sc.)

I.—Developing the teaching of Agriculture at the College. Organizing the practical course and the training of Assistants for the same. In order to make the teaching practical and interesting it will be necessary to do a large amount of touring so as to get acquainted with local conditions. The College work will take up the greater part of the time, the course being new and its scope not yet clearly defined.

II.—The experiments at the Lyallpur Agricultural Station will be continued, the most important being the manurial series, the green manuring series, the rotation series, and tillage experiments.

III.—The growing of seed for distribution of varieties handed over by the Economic Botanist.

IV.—The trial of new implements and developing the Machinery Depôt. A systematic collection of indigenous and some foreign implements will be made for use chiefly in teaching work.

V.—Starting Poultry breeding. The idea is to develop a cross between an English and indigenous breed to suit local conditions.

VI.—Miscellaneous work such as work in connection with tenants, training of assistants, etc.

IV.—Programme of the Economic Botanist.

(D. Milne, B. Sc.)

The College.—The greater part of the time of the Economic Botanist will be taken up in the preparation and teaching of the courses to be given in the College. Although most of the furniture and instruments essential for starting the courses have now been obtained, considerable work has still to be done in this direction, and in organising the biological section of the College generally.

Botanical sub-section.—So far as time and staff will permit, the following will also be attended to :—

Fruits.—The laying down of an area in fruit trees representing those of economic importance in the Province.

Teaching collection of plants.—Continuation of the work in connection with the planting of a collection of plants to illustrate the natural orders which the students will have to study.

Cassavas.—Continuation of the experiments to discover whether cassavas could usefully be grown in the Punjab as a cheap food crop.

Dates.—Investigation into the state of date cultivation in the Province and the possibilities of its improvement and extension, and the planting of a certain number of selected varieties.

Flax and jute.—Further investigations and experiments in growing and retting flax and jute with a view to ascertaining whether these could be profitably introduced as farm crops in the Punjab.

Cottons.—The continuation of plant to plant selection of indigenous and foreign cottons and of the botanical and the economic survey of the cottons of the Punjab and North-West Frontier Province.

Wheats.—Further work on the classified wheats of the Punjab. It is expected that sufficient seed will be produced by May 1910, to allow of experiments being undertaken in various parts of the Punjab to discover which of the selected varieties are best suited to the natural conditions of particular districts.

Mycological sub-section.—There is still no one to assist in this sub-section and so only the most pressing problems that may arise will be dealt with by the Economic Botanist.

Entomological sub-section.—The staff in this sub-section now consists of an Assistant Professor and one Agricultural Assistant.

The teaching work will occupy the greater part of their time.

As far as time and staff will permit, the following work will also be attended to :—

Collection of insects.—The collection of insect pests common in the Province and of local notes on them will be continued.

Boll-worms and parasites.—Special investigations on boll-worms and their parasites.

Outbreaks of pests.—Outbreaks of pests among the crops of the Province.

Silk and Lac.—Investigations and experiments in connection with the silk and lac industries.

Honey bees.—The improvement and extension of honey bee farming.

Mr. Renouf stated that the second Agricultural Station referred to would be situated at Gurdaspur.

Mr. Barnes explained that owing to the undeveloped condition of the Agricultural College of which he is Principal and the consequent lack of trained assistants, it is, at present, necessary for him to devote his attention mainly to the educational side of his duties with consequent necessary neglect of research work. He, therefore, proposed the deletion of paragraph 2 of his programme as it is uncalled for, but subsequently withdrew this proposal on the suggestion of Mr. Couchman that its inclusion in the report would serve to indicate and place on record the difficulties of combining the duties of teaching and research work. Mr. Barnes foreshadowed the future necessity of duplicating the staff of an Agricultural College in order to allow of research work being carried on, but emphasized the necessity of placing the educational work in the hands of experts as being of primary importance, and was supported in this view by Mr. Clouston, who pointed out that the possibility of successfully bringing the results of experimental work to the notice of cultivators depend mainly upon the efficient training of native assistants. Dr. Mann concurred with this view but stated that owing to the pressure of administrative and teaching work, most of the actual research work done was carried out by the subordinate members of his staff under his supervision.

19. The Board accepts the Programme of the Punjab with the modifications suggested in the report of Committee B (Appendix B, page 48).

4.—BOMBAY.

I.—Programme of the Deputy Director of Agriculture.

(T. F. Main, B. Sc.)

This programme may be conveniently referred to under three sub-sections :—

I. Administrative duties.

II. Experimental Investigations.

III. Practical District work.

1. *Administrative duties* :—

I have now six experimental stations with nine sub-stations attached thereto. A synopsis showing descriptions and objects of these stations is attached.

My staff consists of :—

2 Divisional Inspectors.
6 Farm Superintendents.
2 Assistant Entomologists.
2 Cotton Supervisors.
10 Graduate fieldmen.
14 Non-graduate fieldmen.
10 Clerks (including office clerks).
4 Miscellaneous men including store-keepers and the like.

50

It will thus be seen that my establishment involves a good deal of purely administrative work on my part and that a large portion of my time is taken up in directing and supervising these men. I delegate a good deal of work to the senior members of my staff such as Divisional Inspectors, Farm Superintendents, Cotton Supervisors, and Assistant Entomologists, subject to necessary control.

2. *Experimental Investigations* :—

The attached synopsis summarises the objects of the experimental stations.

Crops.

Cotton receives the major share of my attention and in this respect investigations have resulted in positive results as will be explained hereafter. The methods for improving cotton consist of (*a*) hybridization, (*b*) selection, (*c*) trial of varieties in addition to experiments in manuring, irrigation, tillage and the like.

In Southern Gujarat and the Southern Mahratta country quality without sacrificing quantity is the object aimed at while in Khandesh quantity is the chief object.

Wheat is also receiving special attention from the economic point of view. Selection is principally relied upon as the means of effecting improvement but hybridization and varietal trials are also adopted. Increased yield per acre is the chief objective but investigations are in progress to substitute wheats of naturally superior quality in parts at present producing inferior wheats.

Jowar is being carefully selected at Surat and Dharwar with the object of increasing the yield per acre.

Ground-nuts are being extensively experimented with and results of practical value have been obtained with a few varieties (*a*) for irrigated crops and (*b*) for dry crops. The cultivation of ground-nut in alternate rows with cotton and also with a cereal such as *jowar* or *bajri* has been conducted for some years past and the practice has met with the approval of cultivators in Gujarat.

The variations in oil content, percentage of husk and yield per acre are being fully investigated with the assistance of the Agricultural Chemist. Similar investigations with other oil seeds such as *til* and castors are in progress.

Among pulses *tuer* and gram are receiving chief attention.

Tobacco.—Nadiad Station is situated in an important tobacco centre. Experiments in barn curing are being made. Cultivation under shade with the object of studying the influence upon the texture of the leaf is in process of investigation. A suitable site is being tested for laying out a special experiment with potash manures as recommended by the Imperial Institute because it has been found that Nadiad tobaccos are markedly weak in potash and presumably for this reason bad in burning quality. Hitherto variety trials have been made with types suitable for cigar wrappers. There is reason to believe that varieties suitable for cigarette or pipe purposes would be more suitable to Nadiad conditions and steps are being taken to obtain seed of these tobaccos.

Potatoes are being experimented with at Belgaum and Dharwar. The experiments are devoted to methods of planting, quantity of irrigation water required, artificial fertilizers, insect preventive measures and varietal trials.

Soils.

Conservation of moisture.—Various methods of tillage including deep ploughing and subsequent firming the subsoil while retaining a loose mulch on the surface are carried out. Deep *versus* shallow cultivation for various crops is under investigation.

Alternate strips of cropped and bare fallowed areas are being compared with the whole area cropped.

The economy of bare fallow is being investigated.

Manures.

Bulky manures such as farm yard, poudrette, tank mud, road sweepings also cake manures including castor and safflower also artificials especially nitrogenous fertilizers such as sulphate of ammonia are being extensively tested for dry as well as irrigated crops. It is proposed to greatly extend such experiments throughout the districts on the lands and crops of cultivators.

Implements and machinery.

Chief attention is being paid to ploughs, pumps, chaff cutters, threshing machines and oil engines. Special ploughs suitable for definite localities and for definite purposes can now be recommended. Investigations on these and other implements such as winnowers, mowing machines and hand gins will be continued. A feature of the work is co-operation with an Indian Firm of Agricultural Engineers.

Entomology.—Experiments in eri-culture are now in progress at two places and it is hoped shortly to take up lac.

With regard to injurious insects the potato moth (Lita Solanella) is receiving special attention both in the field and in the store. Cut worms are also being combated by means of Vaporite. No success against white ants has yet been obtained. Active measures against the rice and other hoppers are being taken.

Poultry.—Experiments are being started at Surat with two breeds of fowls.

III. Practical District work.—This branch of work has been greatly expanded in the last year or two, and it takes the form of supporting and assisting Agricultural Associations in carrying out semi-independent investigations such as experiments with implements and manures.

Exhibitions, Shows and Demonstrations are now a continuous feature of the Department's activities. Seed distribution is restricted to what can be confidently recommended as an improvement on existing seed. This branch of work has now developed greatly and last June we were unable to meet the demand for seed of hybrid and improved cottons. Hybrid cotton distributed in Gujarat last year fetched a better price by 4 to 5 per cent. in the market than the *deshi* article.

Groundnut seed is also largely distributed. At Dharwar for the last two years it has been necessary to organize an auction sale for the disposal of the cotton grown by cultivators from the Department's seed and this will be repeated in the coming year but it is hoped ultimately to delegate this work to the Dharwar Agricultural Association. The prices realized at the last auction were Rs. 150 to Rs. 172 per *naga* of 1,344 lbs. *kapas*, for the produce of Broach seed distributed by the Department against a price of Rs. 114 per *naga* obtained for the local Kumpta cotton.

Manures are distributed on a smaller scale. Sulphate of ammonia is much appreciated by sugarcane growers. Implements are being popularized by practical demonstrations on the farms and at shows and exhibitions and the demand for these is rapidly growing.

Preventive entomology is now being practically applied in the district in the form of destructive measures against the rice hoppers and I am organizing two elaborate schemes in co-operation with the Collector of Belgaum for the further development of this line of work.

Cattle-breeding.—The *Kankreji* herd at Surat is being organized on the lines of a breeding herd with the object of supplying the best type of bulls for the Province of Gujarat.

General.—The chief new feature in my staff is the appointment of two Divisional Inspectors of Agriculture and the probable appointment of a third. These men have for their special duty, slow touring from village to village throughout the district with the object on the one hand of bringing to the notice of cultivators all that we have to teach them and on the other hand of studying the special requirements of agriculturists by personal observation and discussion on the spot.

Statement showing description and objects of the Experimental Farms and the Sub-Stations attached thereto.

Name of Station.		Tract represented.	Area in acres.	Type of soil.	Elevation in feet.	Average rainfall in inches.	Average temperature.		Principal crop under investigation.
Head.	Sub.						Maximum.	Minimum.	
Surat .		South Gujarat	165 arable. Grazing 150	Black cotton	About sea level	39	106°	51°	Cotton, *jowar* ground-nuts, *tuer* and *tal*.
	Broach	Do.		Do.	Do.				Cotton.
	Navsari	Do.		Do.	Do.				Do.
	Shahada .	Tapti Valley		Black .	Do.				Wheat.
	Dumas .	Surat Dist.		Salt . .	Do.				Reclamation.
Nadiad .		North Gujarat	44	Alluvial loam	Do.	35	114°	43°	Tobacco, cotton-wheat, *bajri*, miscellaneous pulses, oil seeds, etc.
Dharwar .		S. M. Country	136	Black cotton and a small area of red soil.	2,580	32	100°	50°	Cotton, wheat, *jowar* groud-nuts, til, castors and other oil-seeds, *tuer*, gram und other pulses.
	Gadag .	Do.		Black cotton					Cotton, wheat and *rabi jowar*.
	Belgaum .	Do.		Red laterite					Potatoes.
	Kelgeri .	Dharwar District.		Red soil					Do.
	Kumbarganvi	Do.		Light soil					Buri cotton.
	Sirsi .	North Kanara		Garden soil					Botel Palms.
Dhulia .		Khandesh	28	Medium black cotton soil.	844	22	114°	36°	Cotton, ground-nuts, *bajri*, wheat and til.
Dohad .		Panch Mahals	58*	Brown loam to clay.	1,001	30	108°	44°	Maize, wheat, rice, cotton, ground-nuts and other oil-seeds ; gram, *tuer* and other pulses.
Gokak .		S. M. country	66	Sandy loam and black soil.	2,500 (about)	25	100°	..	Sugarcane, ground-nuts, maize, Sann, cotton, *jowar* and fruit trees will be continued.

* Out of 58 acres and 9 Gunthas, 32 acres are utilized for farm purposes and 22 acres have been let.

II.—Programme of the Deputy Director of Agriculture, Sind.

(G. S. Henderson, N.D.A., N.D.D.)

The following are the main features of agricultural work in Sind:—

Agricultural Stations.

Mirpurkhas	Lower Sind.
Sukkur	Upper Sind.

Reclamation Station.

Doulatpur.

Sub-Stations.

3 in South Hyderabad,

3 in North Hyderabad,

3 in North Sind.

and others according as men are available.

Shows.

Shikarpur in Upper Sind.

Talhar in Lower Sind.

Sehwan in Larkana District.

Pithoro in Thar and Parkar District.

Demonstrations and Lectures.

These are held in all districts by itinerant instructors. They usually take the form of working implements accompanied with the distribution of illustrated leaflets in the vernacular.

Manufacture and Distribution of Implements.

Ploughs, levellers, threshing machines and water lifts are being manufactured and distributed.

Introduction of Specific Crops in Various Districts.

Egyptian cotton cultivation on the Jamrao canal area,

American cotton in Hyderabad Disfricts,

Lower Sind cotton in Upper Sind,

and various selected cereals and leguminous crops, etc.

Mirpurkhas Farm Programme.

Principles of rotations with special application to perennial canal cultivation. Trial and selection of suitable rotation crops. Cotton cultivation including Egyptian, American and the Chief Indian varieties. Trials of leading varieties of *jowars*, *bajris* and maize. Selection and trials of wheats and miscellaneous crops. These form the main branches of the work, specific details are to be found in the annual reports and cropping schemes.

Doulatpur Reclamation Farm.

The work on this station is being carried out on the lines already laid down.

Sukkur Farm.

This is a newly established farm and is being at present got into order. It forms the head-quarters for Upper Sind and its chief features will be the introduction of new crops into the district, chiefly cotton and pulses and leguminous crops.

Sub-Stations.

Each group is under the charge of an itinerant instructor and each plot is designed to serve the needs of a district not in touch with a main farm. The travelling instructors use these stations for demonstrating on crops, etc., suitable for the special district. At the head-quarters of each instructor a seed-store is established.

Investigation of Specific Agricultural Conditions.

These are carried out from time to time, *e.g.*, tobacco cultivation in a certain district, various crop diseases and the condition of Agricultural cattle, etc.

III.—PROGRAMME OF THE PROFESSOR OF AGRICULTURE.

(J. B. KNIGHT M. Sc.)

My programme for the year will be a continuation of last year's work with the exception of the sugarcane crushing and testing of water lifts which should be left out.

It may be summarized as under :—

Sugarcane (A) Manure Experiments.

1. Testing value of mineral manures.
2. Do. of Potash and Phosphorus.
3. Do. best combination of coarse and concentrated manures.

Sugarcane (B) Irrigation Experiments.

1. As to quantity.
2. As to interval.

Sugarcane (C) Effect of age and time of planting, method of manuring soil and method of manufacturing, on quality of *Gul.*

Sugarcane (D) Preliminary work in sugarcane selection.

Ground-nut.

Varieties testing as to value in different localities and manure experiments.

Experiments in conservation of soil moisture, continuation of *rab* experiments at Lonavala, etc.

No new work is contemplated.

IV.—REVISED PROGRAMME OF THE ECONOMIC BOTANIST.

(W. BURNS, B. Sc.)

I. Work on Fruits.—It is proposed to study the varieties of the important local fruit crops with a view to description, classification and selection. Observation and experiment will also be made, as far as possible, on the effect of changes of soil condition and water-supply on the fruits. The diseases of these fruit crops will be investigated from the point of view of finding suitable remedies. The following are some special questions which it seems desirable to study :—

(1) The possibility of extracting and using plantain fibre in a profitable manner.

(2) The effects of crossing mango varieties.

(3) Comparison of budding and grafting the mango.

(4) The pruning of the mango.

(5) Comparison of European and Indian methods of grape-culture.

II. Work on Field Crops.—Diseases of crops will receive attention, especially the *tikka* disease of ground-nut, the wilt disease of *tur* and the rust disease of wheat. In the case of the rust disease of wheat the object is to observe the rela-

tions between climate and rust attack and to record these statistically. The following are some special questions which I propose to study :—

(1) The varieties of Tapioca. The varieties in the prussic acid content of tapioca tubers (in collaboration with the Agricultural Chemist).

(2) The growing and distilling of lemon-grass.

(3) The variations of the cotton leaf as indicated by Mr. Leake's leaf-factor.

(4) The quality of fibre from shaded Sisal.

(5) The quality of jute produced in Bombay.

III. Miscellaneous.—Several plants will be tried as hedging material. Silk culture will be continued with both castor and mulberry silk. Instruction in horticulture and silk culture will be given.

V.—Revised Programme of the Agricultural Chemist.

(H. H. Mann, D. Sc.)

The main lines of work to which it is intended to devote attention during the year are :—

(1) The question of the "*Rab*" process in rice cultivation and the problems which rise out of it. This is in consultation with Mr. Knight who has field experiments in hand, and who has been working at the problem for five or six years.

(2) The method of dealing with the salt lands of the Nira valley and other salt tracts in the Deccan, and the problems relating thereto.

(3) The sources and amount of loss in the manufacture of *gur* and how they can be avoided, and the bye-products utilized.

). It was agreed that the modifications suggested by the Committee in respect to this Programme should be adopted.

Mr. Couchman referred to the good work that had been done by Mr. Henderson in the reclamation of salt areas in Sind and regretted that no reference had been made in this Programme to the continuance or otherwise of this line of enquiry. Mr. Keatinge pointed out that full reports had been published during two consecutive years dealing with this subject.

l. The Board accepts the Programme of Bombay with the modifications suggested by Committee B. (Appendix B, page 48).

5.—MADRAS.

I.—Programme of the Deputy Director of Agriculture: Southern Division.

(H. C. Sampson, B.Sc., F.H.A.S., F.B.S.E.)

AGRICULTURAL STATIONS.

(a).—Koilpatti.

1. *Indigenous cotton.*—The work of selection will be continued. Several types of plants which have been selected for quality and high percentage of lint are now being tested for yield and it will, it is hoped, now be possible to confine selection within certain limits of known types suitable to different areas of rainfall. Careful notes and figures of the type and period over which picking continues will give this information, which, it is hoped, will enable the department to extend a suitable type of Karunganni to those parts of the Tinnevelly district where the period of picking is confined to only 2½ months.

2. Manurial experiments with cotton grown in rotation with a cereal will be continued. The rotation experiments of other crops grown in rotation with cotton will be continued as also the effects of deep *versus* shallow cultivation, which experiment is worked conjointly with the rotation experiments.

3. Spacing experiments will be continued. These must extend over a series of years in order to strike an average as to the best distance. In seasons of a shortage of rainfall, when the development of the plant is less, closer planting will be more profitable but as the rainfall cannot be foreseen, the best average distance must be discovered.

4. The cultivation of Cambodia cotton will be continued. This is now largely grown in the districts on lands which can, if necessary, be commanded by wells. Its shallower root system precludes it from ever becoming a serious rival of the indigenous cotton on dry black cotton soil.

5. Different varieties of *cumbu* (*Pennisetum typhoidium*) are also being tested. This must be continued until the introduced varieties have become thoroughly acclimatised.

6. The question of taking up the introduction of varieties of *cholam* for the black cotton soil has, for the present, been abandoned. Any new varieties are being grown on red soil where they can be sown earlier and their period for ripening can, to some extent, be gauged. Introduced varieties of *cholam* on the black soil here have never formed grain properly, though this is not the case on the red soil.

7. *Koilpatti red soil block.*—This is a shallow red grit alleviated by heavy manuring and heavy dressings of tank silt. Such lands are usually commanded by wells and are largely taken up by petty ryots who by their own industry and continual hard work can make a living off them. On such land which has to be continually improved by carting silt, experimental work is impossible. New varieties of crops are grown and tested and if profitable their value is demonstrated to the ryots. New methods of cultivation and manuring are also compared and demonstrated. The following are items which can be shown to the ryots as better than their own or are still under trial.

8. *Plant introduction.*—Bombay onion from Dhulia—

Raising onions from seed (South Arcot variety and practice).

Raising onions from bulbs secured from crops grown from seed (South Arcot variety and practice).

Cumbu varieties (these are still being tested).

Cowpea varieties (these are still being tested).

Cholam varieties (ditto).

9. *Improved methods of cultivation and manuring.*—Planting *ragi* on ridges instead of in flat beds for flood irrigation. The use and value of poonac (neem) as a manure for cereals raised under well irrigation.

(b)—*Palur.*

1. *Ground-nuts.*—Exotic and other varieties of ground-nut will be tested and compared with that now commonly grown locally. Now that several of these introduced varieties are becoming acclimatised, they have begun to show considerable improvement.

2. Experiment has now for the last two seasons shown that the local method of irrigating and cultivating ground-nuts in the hot weather season is the best, as the crop much sooner covers the ground and the hardened soil caused by flood irrigation acts as a check to insect attacks to the roots. These experiments will be discontinued.

3. Rotation and mixed cropping experiments of ground-nuts and cereals in the monsoon season will be continued. This is likely to give valuable information and results.

4. The permanent manurial experiments conducted with irrigated ground-nuts will be continued. These are aimed at for ascertaining the value of lime in various forms to this crop.

5. Monsoon crops are being tested on land such as irrigated ground-nuts (hot weather season) are usually grown upon. Such lands are usually in the hands of small tenants who have to pay high rents either in share or money to the land-

lord. The object of these trials is to test the effect of these crops, many of which pay well for careful attention, on the following irrigated ground-nut crop.

6. Cambodia cotton is being tested as a crop on the above-mentioned class of land. This has proved so valuable to the cultivators of lands commanded by wells in Tinnevelly, that it is being tried here, where a valuable money crop is sadly wanted to compete with ground-nuts on this class of lands, so that the land may get a rest from the continual cultivation of the same crop. Already ryots feel this point and many of them grow indigo at long intervals although this is not a paying crop at present prices, nor is it a suitable rotation crop, being also a legume.

7. The cultivation of new varieties of dry land cereals which was taken up last year will be continued.

8. *Wet land crops and cultivation.*—The Mauritius varieties of sugarcane will be grown on small areas on a sufficiently large scale to test yields. The red Mauritius has now largely replaced the local cane, but whether this is better than other varieties still remains to be definitely proved.

9. The trial of various plants for green manure will be continued. *Sesbanea aculeata* has this year given excellent results.

10. The work with the paddy crop will be continued which includes experiments to test the various locally available manures, experiments with different methods of planting and variety tests.

(c)—*Taliparamba.*

1. The study of pepper crop on the Coastal region of Malabar and the lines of work which were originally laid down will be continued.

2. *Wet land cultivation.*—The value of green manuring crops will again be demonstrated. These include cowgram and ground-nuts, the former sown in April, May and the latter in October.

3. The cultivation of sugarcane will be continued in order to supply sets to intending cultivators of the district where the crop is little known and where its cultivation has proved so successful. The farm crops will also serve as a demonstration of the best methods of cultivation.

4. *Dry cropping, etc.*—This will be continued on similar lines to those laid down last year.

(d)—*Work outside the Agricultural Stations.*

1. The work in Tinnevelly district outlined last year will be continued. Seed farm areas will, however, be limited to 1,000 acres from which the whole of the seed to be distributed will be purchased. This should mean sufficient seed to sow 30,000 acres. Village depôts for the sale of seed will be extended to new centres. These are found more satisfactory than larger depôts as it enables the cultivator to buy when he likes. The extension of drill cultivation in this district will still need help from the department though already many ryots are now using the drill independently of the department having had the necessary implements made in their own villages.

2. Similar work to the above, which has been started this year, will be continued in the black cotton soils of the south of the Madura district, while work on these lines in Trichinopoly district must be held in abeyance until the sanctioned appointments of subordinate officers can be filled up.

3. Work with Salem cottons in Salem and Coimbatore district shows, on more detailed enquiry, that there is little possibility of an extension or of improvement in the cultivation of this crop unless it can be grown under irrigation. The soil is poor and shallow, the rainfall is uncertain, and only certain classes of soils will carry the Bourbon cotton. At present all lands under wells are devoted to raising food grains but as cotton requires much less irrigation than a cereal, it may, in the event of a good season, when grain is plentiful on dry lands, be possible to get this crop grown on land where the supply of water in the wells cannot be depended on without the help of rains to raise a cereal crop.

4. In South Arcot and the Cauvery delta, there is a large scope of work in the introduction of suitable green manure crops and now that the price of food-grains is high, it is an excellent opportunity to get people to adopt this system of manuring.

5. There is also scope in South Arcot district for the introduction of inexpensive labour-saving implements. Work has been started with the introduction of the harrow, which implement is now being made by local blacksmiths.

6. On the West Coast the ground-nut crop now shews signs of having become established but some further assistance may yet be necessary from the department.

7. The introduction of improved varieties of sugarcane on the West Coast is slowly making headway. This work will also be continued.

8. The introduction of improved varieties of maize will be attempted in those parts of North Arcot, Salem and Tanjore districts where this crop is already grown. The one serious difficulty here is that this crop, being wind fertilized, will readily cross with the local varieties and will soon deteriorate, if grown too close to crops grown from local seed.

9. Better methods of raising paddy nurseries and of planting paddy are being introduced into most districts especially into big rice growing tracts such as the Cauvery and Tungabhadra deltas.

10. The experience of the Department has been that fibre crops are not sufficiently profitable to cultivate at present, as lands suited for their cultivation will, with the present high prices of food grains, give a better monetary return at less trouble if grown with a cereal. Trials with these crops will therefore be, for the present, abandoned.

II.—Programme of the Deputy Director of Agriculture, Northern Division.

(R. W. B. C. Wood, B.A.)

As noted in my last year's programme, the plant-to-plant selection of the common cultivated crops of the division will be continued. The work is somewhat hampered by the inexperience of the assistants, but some of them are now being trained in the principles on which this work is to be done.

At the Bellary and Hagari stations, the year's work so far as the dry land of each farm is concerned, is the reproduction of the selected seed obtained from the selected plants, cultivation experiments with cotton, selection of single plants of all crops in order to practise the assistants in this work and with a view to obtain better and purer strains, rotation, and manurial experiments, and variety tests with early and late sown *jonna* (sorghum). At Hagari, the addition of a garden fed by a well recently sunk, will enable a practical demonstration to be made of the intensive cultivation which is possible in such conditions, and it is hoped to stimulate such cultivation and thus make the district more secure against famine than at present.

Nandyal is becoming increasingly useful. The work carried on is similar to that outlined in last year's programme. The outside work of cotton distribution will, it is hoped, continue to increase. A large quantity of seed will be available from the crops now standing in the district. The results of selection continue satisfactory and recent expert testimony confirms the value of the work. The prevalence of smut being noticed during a tour by the Deputy Director during last season, plots to test the strength and efficiency of a "dressing" have been laid out both here, and at Hagari. Early sown crops have been discarded here, as the land has been found unsuitable and it was considered that continued failure would tell against the reputation of the farm.

The lands at Bezwada are not yet in a fit condition for experiment as they are still foul with grass and weeds. The cultivation of an exotic cotton "Cambodia" seems promising and will be continued. Two distinct types are already evident in the country cotton and will be sown separately for comparison. A few very simple cultural experiments will be continued.

Samalkota.—The sugarcane experiments have been again slightly altered in consultation with the Government Botanist and the Agricultural Chemist. The demand for canes in the delta being practically over, distribution further afield is being taken up. The success of the Barbados cane 208, being marked, its spread will be effected as rapidly as possible.

The lengthening of the cane rotation has brought an increased area under paddy and experiments with the crop, manurial and cultural, will be continued. Seed selection is promising and in view of the export trade from this district in paddy, purity of sample will probably have a direct commercial value. This question is being investigated.

District work will include the following :—

(*a*) Work in the Kistna delta to find a suitable substitute for the village earth (*pŭtinamnu*), at present the only source of manure.

(*b*) Demonstrations of deep ploughing and the sale of ploughs in the Kistna dry lands and the cotton soils of the Nandyal valley.

(*c*) Distribution of improved varieties of cane throughout the East Coast of Madras from Ganjam to Nellore.

(*d*) Introduction of groundnut crop into the Vizagapatam and Ganjám districts.

(*e*) Demonstration in all paddy-growing tracts of the success of singly transplanting paddy seedlings after suitable treatment in the seed bed.

III.—Programme of the Principal.

(C. J. W. Shepperson, B.Sc.)

1. The experiments on the water requirements of irrigated garden crops will be continued, as also the testing of the ridge and furrow method of tranplanting *versus* the bed system.

2. Experiments will be continued on the question of the best rate at which to sow *ragi* nurseries and the best age at which to transplant.

3. The experiments on paddy spacing and seed rate will be continued.

4. Attention will be paid to the growing of green manure crops on paddy lands in the dry season, various plants being tried for the purpose.

5. The experiments upon the question of deep ploughing and fallow ploughing will be continued as well as the comparison of different methods of intercultivation.

6. The growing of as many varieties as possible of South Indian crops will be continued for the instruction of students, and seed selection will be practised in all cases.

IV.—Programme of the Agricultural Chemist.

(W. H. Harrison, M.Sc.)

The new laboratories were properly equipped when the college was opened in June 1909, but the want of a pot culture house, which, latter however, has been recently sanctioned, has delayed the continuance of much experimental work.

Much time must necessarily be given to the course of studies in Elementary General Chemistry, Agricultural Chemistry and practical Chemistry in order to make them fill all the requirements of students who are only taking the general course for instruction for the Diploma and at the same time to eliminate all redundant matter.

The analytical and routine analytical work is increasing very rapidly and it is now necessary to employ two of the assistants upon this work alone.

The attention required by the students and the analytical work, together with the want of an assistant who could be specially deputed to assist in research and investigations, has interfered greatly with the latter, but fair progress has been made in many of the directions laid down in last year's programme. The main features of that programme will therefore constitute the work of the ensuing year in this branch.

V.—Programme of the Botanist.

(C. A. Barber, M.A., F.L.S., D. Sc.)

1. The general control of the Entomological and Botanical assistants. In teaching, the delivery of a course of Elementary Botany and, with the aid of an assistant, one on Agricultural Botany. The general superintendence of the course on Elementary Zoology in preparation for Veterinary work.

2. The upkeep and improvements of the Botanic garden, the college compound and the avenue of the Lawley road.

3. The study of cottons of the Presidency, *Hibiscus Cannabinus*, *Pennisetum typhoidium* and castor oil plants, their characters and those of hybrids obtained by crossing. The study of crosses of certain ornamental plants in the garden.

4. The formation of a collection of agricultural products of the Presidency for the College Museum and Botanical Laboratory.

5. The charge of the Herbarium of Madras plants now in the building.

6. If time permits, the continuation of the study of Phanerogamic root-parasites.

The Board accepted the Programme of Madras.

6.—CENTRAL PROVINCES AND BERAR.

PROGRAMME OF THE DEPARTMENT OF AGRICULTURE.

(P. Hemingway I.C.S., Director of Agriculture.)

Agricultural Stations.

The four agricultural stations will be as in preceding years. Implement depôts of the type already existing in Nagpur and Hoshangabad have been started on a small scale at Akola and Raipur also. The bull-breeding farms at Hoshangabad and Nagpur will remain as before : but at Nagpur a more rigid casting of stock will be introduced in order that we may issue only the best animal for breeding purposes, even though the type selected and maintained does not possess in a marked degree all the fanciful characteristics that appeal to the native breeder or *Goalas*.

In the northern circle small plots of land will be taken up in the following districts for the following reasons :—

Jubbulpore.—A small plot under a Government irrigation work, on which can be demonstrated, after experiment, the most economical use of irrigation in the crops and soils of the Jubbulpore district. Conditions of this tract differ widely from those pertaining to the Hoshangabad Farm : and for a year or two the work here will be largely experimental. When the work gets to the demonstration stage, this farm will be stopped, and a regular demonstration programme started to cover the whole tract.

Damoh.—A similar plot will be taken up in land embanked by the Irrigation Department. At present much of this improved land is fallow, for tenants do not know how to use it. As in Jubbulpore, work will be for a year or two experimental, and the farm temporary only.

Nimar.—A similar small plot, for the growth of cotton. This will be more demonstrative from the outset : but it cannot be wholly regarded as a demonstration, for the rainfall and soils are very different from those found at Akola and Nagpur. With the advice of Messrs. Clouston and Gammie, it is hoped that Mr. Evans will be able to demonstrate the possibility of growing better varieties of cotton.

These three temporary farms are really demonstrations: but some experience must be gained; and by the time that knowledge has been attained fully, the staff should be available for the institution of a demonstration programme on a large scale.

The principal experimental work is given below:—

Cotton.—The chief experiments in cotton will be carried on by Mr. Clouston at the Akola Farm, in consultation with Mr. Gammie. Plant-to-plant selection will be in its fourth year, the object being to increase the yield of *buri* and of indigenous varieties; to get a higher percentage of lint to seed in all varieties; and to improve the fibre of *buri* and *malvensis*. Selected varieties will cover 175 acres at this farm. Hybridizing will be continued, but will be confined to the crossing of *bani* with the *jari* types.

This work of selection will also be carried on at Telinkheri and at Nagpur, in co-operation with Mr. Allan on the latter farm.

The experimental series dealing with rotation, tillage, spacing, manure, and topping will be continued. The advantage of sowing cotton before the break of the rains, the value of *bhendi* as a trap crop for bollworm, and the advantage of growing peas, gram and other leguminous crops as soil renovators between rows of cotton will be tested.

Wheat.—The experimental series detailed in the last programme will be continued at Hoshangabad under Mr. Evans, Deputy Director of Agriculture. Another experiment of importance that has been started is the double-cropping of embanked land on typical heavy soils: a catch crop of rice followed by valuable rabi staples in embanked lands is found on large areas in both the north and south of the Provinces; and it has generally been reported that this practice has not extended to the Hoshangabad wheat tracts, because the soil does not embank well: this will now be tested. The experiment in wheat from the stand-points of rust and drought resistance, quality and yield are of great importance. The non-experimental area of this farm will be practically devoted to propagation of select seed for distribution. The effect of irrigation in changing the character of wheat will again be watched.

Rice.—The experimental series in connection with rice at Raipur will not be altered. Mr. Graham will be able to hand over to Mr. Clouston for further trial several new varieties, selected after classification. Plant-to-plant selection of approved varieties will be continued. On the small area available for rice at Telinkheri selected varieties will be grown for distribution. An experiment to test the value of wild lucerne (*Melilotus alba*) both as a fodder crop and as a soil renovator for land which grows rice continuously without manure may be of great help in solving the manure and fodder question for Chhattisgarh.

Miscellaneous crops.—Plant-to-plant selection of cane will be continued at Raipur. Different varieties of ground-nuts will be further tested at Raipur, Akola and Hoshangabad: and selection of *tuer* will be continued in order to improve out-turn and find a wilt-resistant variety. The trial of local grasses on the Akola Farm is giving good results: a leguminous weed (*Alysicarpus rugosus*) will be added to all the plots in the ensuing year to improve their pastural value.

Manurial experiments.—There is some possibility that sulphate of ammonia may become available in large quantities at Nagpur, in the near future: the continuous series that contain this will therefore be of particular interest.

Agricultural education.—It is trusted that work will be started on the College laboratories in the near future. During the current year the hostel has been improved considerably: and the Principal, Mr. Allan, personally conducts the direct agricultural teaching of the various years. On the farm adjoining the College, some cattle-feeding experiments will be started.

Agricultural Chemist and Economic Botanist.—Messrs. Plymen and Graham will continue to work in conjunction with officers in charge of farms: in the selection of cane and wheat Mr. Plymen's work has already been of great use. In conjunction with Mr. Allan, Mr. Plymen will study the moisture contents of back cotton soil under different systems of cropping and cultivation: he will also examine

the effects of some of the well waters used for irrigation, and assist Mr. Evans in the enquiry about the comparative suitability of the Nerbudda Division soils for embanking.

Classification of the *juars*, sann hemp, *bajra*, *Capsicums*, and rices will be the chief work of Mr. Graham. The collection of economic plants will be amplified: it will be extended round the new laboratories when that land is available.

Whenever possible, these two officers will tour in the various tracts of the Provinces.

Demonstration.—The work under this head is increasing. An area of about 4,000 acres has been under the supervision of Mr. Clouston this year in Chhattisgarh, the work being transplantation of rice, irrigation of wheat, and cultivation of cane and ground-nut. In the ensuing year similar work, with the addition of jute occasionally, will be undertaken in the Nagpur Division under the Ramtek reservoir and in the cane-growing tract of Chanda. In order to ensure complete supervision it may prove impossible to increase the area in Chhattisgarh; for every year more centres are made available for this work by the Irrigation Department in other districts: and if a maximum of 4,000 or 5,000 acres in one Division is maintained, with the ground constantly and gradually changing, a complete reformation of the existing conditions will soon be obtained. To further this work, a class for actual tenants or their sons or ploughmen has been started at Raipur: this is really part of the demonstration scheme, for the courses are but of a few weeks only, and embrace the improvements that are carried out in the demonstration centres. The "Kamdars" will gradually increase in number, as men become trained on the farm.

The cotton-seed farms have been, and will be further, amplified into demonstration centres. Assistants in charge of these farms in the current year have also supervised cultivation of *bani* cotton on nearly 600 acres: and with the amount of selected seed now available, of this variety, it is expected that 3,000 acres in Berar alone will be under demonstration next year.

The use of copper sulphate, improved machinery, and conservation of manure are also taught in these demonstration circles.

In the northern circle three centres have already been mentioned. In the current year several wheat-seed farms have been started under the supervision of assistants: these will be increased in number, as rapidly as possible, compatible with supervision; for the high seed rate of wheat makes the multiplication of these centres most necessary. Satisfactory arrangements have been made to ensure that the produce of existing farms will be reserved for distribution: there is now a brisk demand for this selected seed.

Demonstration of implements will be made at all the chief fairs and elsewhere. In the northern circle the conservation of seed potatoes will be further encouraged by demonstration: in the current year that has been most successful. At the Raipur Farm a small vegetable garden has been started, and it is trusted that this will be imitated in the Chhattisgarh Division.

Agricultural Associations.—All meetings will be attended by officers of the Department and the Associations further exploited as a means both of diffusing and gaining knowledge.

Publications.—The *Agricultural Gazette* will be published monthly: bulletins and leaflets also will be issued. Arrangements have been made for the issue of leaflets with selected seed of varieties not commonly known.

The Board accepts the Programme of the Central Provinces and Berar.

7.—BURMA.

PROGRAMME OF WORK OF THE DEPARTMENT OF AGRICULTURE.

(J. MacKenna, I.C.S., Director of Agriculture).

It is not yet known whether funds will be available this year for the Lower Burma Agricultural Station at Hmawbi. It is proposed to defer the selection and acquisition of an Agricultural Station in the dry zone till further progress has been

made in the training of a staff and until the stations at Mandalay and Hmawbi are in full working order. The following are the chief lines of work proposed during 1910 :—

I.—Under the Additional Deputy Director of Agriculture.

(C. Thompstone, B.Sc.)

Mandalay Agricultural Station.

1. *Paddy.*—Experiments include manurial cultivation with locally available manures and rotations with jute already begun. Experiments on watering will, if possible, be begun. Classification of varieties of Upper Burma paddy, begun in 1907, will be continued.

2. *Wheat.*—Extensive experiments in cultivation, rotations and manures have been commenced and will be continued—trials of introduced varieties: classification and description of local varieties.

3. *Cotton.*—Introduction and trial of introduced varieties, some of which give promise of success; selection and classification of indigenous varieties: experiments in cultivation, manuring and rotation.

4. *Jute.*—Jute cultivation gives fair promise of success. Further trials will be made.

5. *Ground-nuts.*—Variety experiments already begun will be continued: experiments in yield, percentage of oil to kernel, and of kernel to whole seed as begun last year.

6. *Jowar and Maize.*—Selection and classification of indigenous varieties; trial of introduced varieties.

7. *Peas and Beans.*—Classification in the field of the large number of indigenous varieties.

8. *Other Crops.*—In rotations and on land which is being brought under cultivation or which is not required for experimental purposes.

9. *Implements.*—Will continue to be manufactured in the Farm workshop for sale or loan. Several new ones are being tried and endeavour is being made to place the trade in the hands of a local manufacturer. Imported implements are being tested.

10. *Seeds.*—Seed production; hand selection and distribution will be continued.

Amongst general work Mr. Thompstone will be engaged with the further training of the staff: with water lift experiments and with the Agricultural Survey of the Yamethin District.

II.—Under the Deputy Director of Agriculture.

(A. Mackerral, M.A., B.Sc.)

(i) The Hmawbi Station.

In the event of this station being opened, work there will consist of—

(1) Laying out operations, consisting of the construction of efficient bunds and the measurement of uniformly sized quarter acre plots.

(2) The cropping of such plots as have been laid out with one variety of paddy and with uniform treatment as regards manuring and cultivation in order to ascertain to what extent variation in fertility among the different plots exists.

(3) The superintending of the erection of farm buildings and offices.

(ii) Agricultural Surveys.

These may be continued in the rains or cold weather season. The survey of the Sagaing District is at present in progress and will be completed in February. That of Myingyan was completed last year. Next year a Lower Burma District will be undertaken in order to furnish material for future experiment at Hmawbi.

In the event of the Hmawbi Farm not being opened, some initial experiments may be attempted with flood resisting paddies, a site being obtained in one of the flooded areas. This would partly occupy the time otherwise devoted to Hmawbi.

(*iii*) *District Work.*

This will consist of special tours in connection with any subject of agricultural importance on which advice is asked by district officers. Last year special tours were made to the Chin Hills in connection with wheat growing there; to Sagaing, in connection with the alkaline tract known as the Yemyit In; to Ma-ubin, in connection with plantain fibre and to Thayetmyo, in connection with the cropping of an area in the Myede Sub-division. Such work will occur next year, and already an enquiry outstanding is that of *taungya* cultivation. The wheat plots of the Chin Hills may also be revisited early in 1911.

(*iv*) *General Work.*

Such as the preparation of leaflets, the collection of seed samples and economic products and the designing of new implements will be undertaken when necessity arises for it.

III.—Under the Agricultural Chemist.

(F. J. Warth, M. Sc.)

The work of the Agricultural Chemist will comprise :—

(1) Completion of the work on silt deposits on the lines of Sir Edward Buck's report.

(2) Analyses of typical soils of the Meiktila District.

(3) Completion of the analyses of soils of the Mandalay Agricultural Station.

(4) Preliminary examination of a few important varieties of paddy. This enquiry will include the composition of various varieties and the determination of the inorganic matter and nitrogen absorbed by them during growth.

(5) Preparation of soils for Pot experiments.

(6) General analytical work for the Mandalay Agricultural Station.

IV.—Botany.

Pending the arrival of the Economic Botanist the Botanical Assistant will be engaged on the following work in collaboration with the Deputy Directors :—

(1) Pea and Bean Survey (continuation of the Survey now in hand).

(2) Upper Burma Paddy Survey (completion).

(3) Wheat Survey (completion).

(4) Study of the oils of Burma (continuation).

(5) Study of the fibres of Burma (continuation).

(6) Survey of the indigenous *Cucurbitaceæ*.

(7) Survey of the Burmese sessamums.

(8) Survey of the Burmese castors.

V.—Entomology.

1. The principal problem is the investigation of the extent of damage to cocoanut trees by the Rhinoceros Beetle and the evolving of a scheme to stay its ravages. It may be necessary to organise a systematic campaign against this pest.

2. *Garden Pests.*—The insect pests reported to have been injuring the Government Orchard at Taunggyi, Southern Shan States, will be studied and necessary remedial measures will be adopted. The head gardener will be trained in the use of insecticides and apparatus.

3. *Cotton Pests.*—The study of the cotton pests of Burma will be completed and a detailed report on them will be submitted.

4. *Fruit-flies.*—The study of the fruit-flies will be continued.
5. *Paddy Pests.*—The study of the paddy pests will be commenced.
6. *Coccids of Burma.*—Collection of the coccids of Burma will be begun.
7. *Classification.*—Of insects that will be reared and collected during the year.

VI.—General.

The issue of leaflets and bulletins, etc., as occasion arises. The question of School Gardens will be gone into.

The Board accepts the Programme of Burma.

8.—EASTERN BENGAL AND ASSAM.

I.—Programme of the Department of Agriculture.

(F. W. Strong, I.C.S, Director of Agriculture.)

There are seven Agricultural Stations in the Province, *viz.*, Dacca, Rajshahi, Burirhat, Jorhat, Shillong, Upper Shillong and Wahjain. The stations at Shillong and Wahjain are principally devoted to the growing of special crops such as fruits, spices, etc. The superior staff of the department has recently been strengthened by the addition of an Economic Botanist and an Arboricultural Expert. Mr. A. G. Birt, who, up to August 1909, was officiating for the Assistant Director, still remains in the Province pending orders from the Government of India.

The laboratory building and the officers' residences at Dacca are now practically complete. Three officers, *viz.*, Messrs. Meggitt, Hector and Birt, are already in residence and Mr. Finlow is expected to remove from Pusa shortly.

Since completion of his training at Pusa, the Agricultural Supervisor, Mr. J. N. Chakravarty, has been in charge of the Dacca Farm. Proposals for increasing the subordinate staff are now under consideration.

2. The following are the chief lines of work it is proposed to undertake next year on the Agricultural Stations :—

(*a*) *Rice.*—The manurial and variety experiments with winter paddy, commenced at Dacca in 1908, will be continued. The chief object of the manurial experiments is to ascertain the effect of green manuring with Dhaincha and Sann Hemp as compared with cowdung, oilcake, and bonemeal.

Experiments designed to test various methods of transplanting rice were laid down in 1909 and it is proposed to continue these. Most of the above experiments will be duplicated at Rajshahi where the land is of a different type.

The Economic Botanist will continue selection and breeding of winter rice at Dacca.

(*b*) *Jute.*—At Rajshahi the experiment to ascertain the residual effect of manures will be continued. The two-year rotation experiment, described in last year's programme, will also be continued. It consists of two rotations : *one*—jute, potatoes, jute, pulse, and the other—jute, pulse, jute, pulse. The experiment with jute refuse, as to its value as a manure, is being continued.

At Dacca, a considerable area of the best varieties will be put down to provide seed for distribution.

Mr. Finlow's full programme is given below.

(*c*) *Sugarcane.*—The experiments at Jorhat and Rajshahi will be continued on the same lines as described in last year's programme.

(*d*) *Potatoes.*—At Upper Shillong the experiments will include—

1. Trials of varieties.
2. Manurial experiments.
3. Spraying with Bordeaux mixture.
4. Cut sets *versus* whole sets.
5. Sprouting of seed.
6. Methods of planting.

At Rajshahi, Upper Shillong and also at Haflong (in the North Cachar Hills), attempts will be made to raise seed for distribution in connection with the efforts which are being made to promote the cultivation of Naini Tal and Darjeeling potatoes. The experiments at Rajshahi, having indicated that potatoes can be grown there successfully without irrigation, will be continued, and steps will be taken to popularize this crop in the district.

(*e*) *Tobacco.*—Next year's work at Burirhat will depend, to a great extent, on the results obtained from this year's tobacco crop and a flue-curing experiment which is being tried for the first time this year.

The Assistant Director and the Farm Superintendent will visit Cooch Behar to study the method of flue-curing followed there. The question of engaging a tobacco expert is under consideration, but no action will be taken until the result of the curing experiment, which we understand is to be carried out at Pusa this year, is known.

(*f*) *Ground-nut.*—Experiments will be continued at Rajshahi and Jorhat to ascertain whether this crop can be profitably introduced. At Jorhat (Upper Assam), where encouraging results have already been obtained, there is a possibility of its proving a remunerative crop for the local ryots.

(*g*) *Lemon grass.*—The cultivation of this grass will be continued at Wahjain, and the possibilities of the lemon grass oil industry will be further investigated by the Economic Botanist in consultation with the Agricultural Chemist.

3. *Demonstrations.*—The demonstrations in the spraying of potatoes and manuring of rice with bonemeal and saltpetre will be continued, if possible, on a more extended scale. It is also proposed to initiate demonstrations on silo-making and grafting of fruit trees. Hitherto very little demonstration work could be done in the plains districts for want of sufficient staff, but under the proposed scheme for the strengthening of the staff we hope to be able to devote more time to this important branch of work. The principal demonstrations to be carried out in the plains are the following :—

(1) Use of bonemeal and green manure for winter paddy.
(2) Improvements in sugarcane-crushing and the manufacture of *gur* and sugar.
(3) Cultivation of fodder crops.
(4) Introduction of potatoes.
(5) The conservation of cattle manure.

4. *Cattle-breeding.*—At Upper Shillong the breeding of Patna bulls for the Khasi Hills will be continued.

The establishment of a cattle-rearing Farm with the object of supplying bulls for the improvement of work cattle in the plains is now under consideration.

5. *Sericulture.*—It is expected to commence rearing work at the Central Nursery, Mirganj, this spring. The object of this and the branch nurseries at Baneswar and Kharkhari will be to raise disease-free seed for distribution to rearers.

Messrs. Anderson Wright & Co. of Berhampore in the Murshidabad district claim to have bred a new polyvoltine race of worms by crossing the Italian with the local "Nistri" worms. This new race they assert to be far superior to the local races. An enquiry will be made as to whether it would be desirable to introduce this new race in supersession of the indigenous worms.

At Shillong, the experiment with the European univoltine silkworms which has proved successful for six years in succession, and the efforts to introduce Sericulture amongst the Khasis, will be continued.

The Sericultural school at Rajshahi will be maintained.

6. *Poultry.*—Experiments initiated by Major Cole with the object of introducing superior breeds of poultry into the Lushai Hills having met with considerable success, will be continued. It has been decided to commence poultry breeding on a small scale at Dacca with Chittagong and Langshan fowls. Mr. Meggitt has offered to superintend the work and a start will be made as soon as possible.

7. *Arboriculture.*—The services of an Arboricultural expert (Mr. R. L. Proudlock) have been obtained. He is at present engaged in laying out the new civil station at Dacca under the Public Works Department, but it is hoped that his services will be available to give advice on the question of fruit culture, etc., carried on at Shillong and Wahjain.

II.—Programme of the Fibre expert.

(R. S. Finlow, B.Sc., F.C.S.)

The major portion of the available time will be devoted to the following :—

(*a*) *Jute.*—The experiments in collaboration with the Reporter on the Economic Products to the Government of India have been advanced a stage, and it is hoped that definite indications will be obtained as to the possibility of improvements by selection and hybridization.

(*b*) *Flax.*—Experimental cultivation of flax with special reference to Assam will be continued. The investigation into the possibility of the utilisation of the cooler tracts of India for the production of good seed has been commenced and will be continued.

(*c*) Advice will be given where required, in connection with experimental trials with jute and other fibres in Eastern Bengal and Assam and in other parts of India.

(*d*) Experimental cultivation of fibres such as *Sida, Asclepias Semilunata, Urena Lobata*, etc.

Other problems which will receive attention, if time allows, are :—

(*e*) Study of the retting of jute and Sunn Hemp from the chemical and bacteriological points of view.

(*f*) Investigation of Heart Damage in jute.

(*g*) Investigation into the possibility of introducing simple machines with the object of (1) lessening the large amount of labour and (2) reducing the large amount of water necessary for the retting of jute and similar fibres.

(*h*) Sources of material for paper-making.

III.—Programme of the Agricultural Chemist.

(A. A. Meggitt, B.Sc.)

1. Training of Assistants.
2. Work on Sugarcane in collaboration with Mr. Birt.
3. Work on Lemon Grass oil with the Economic Botanist.
4. Investigation of local soil problems, especially in connection with experimental farms.
5. Routine analytical work.

IV.—Programme of the Economic Botanist.

(G. P. Hector, M.A., B.Sc.)

1. A general investigation, with a view to selection of the transplanted *aman* rices of the Dacca district and of the varieties of mustard and *til*.

2. A collection of leguminous crops will be grown for observation, and also Bourbon cotton. The question of the plant which produced the "Dacca Cotton" will be gone into.

3. A considerable amount of time will have to be spent on laying out of a botanical area, and the formation of a reference herbarium of cultivated and wild plants of economic importance will be commenced.

4. *Work at Wahjain.*—This will consist chiefly of the study of the local varieties of citrus, the distillation of Lemon Grass oil (in conjunction with the Agricultural Chemist) and the cultivation of pine-apples.

Mr. Strong wished to point out the necessity of strengthening rather than reducing the staff of the Department in this Province which calls for the appointment of a second Deputy Director to enable it to cope with the special conditions obtaining there. The Board agreed that attention should be called to the opinion of the Committee as expressed in their report, (Appendix B, page 49).

The Board accepts the Programme of Eastern Bengal and Assam.

9.—KASHMIR.

Programme of the Department of Agriculture.

(L. C. Sharma, M.R.A.C.; P.A.S.I.; Bar-at-Law).

I. Experimental work at the Pratap Model Farm to be continued on the following points :—

(i) *Varietal Experiments.*—Varietal experiments with wheat, oats, mustard, paddy, maize, tobacco and ground-nuts to be continued as last year, and in the case of mustard, paddy and ground-nuts oats, peas and maize which have given encouraging results so far, trials will be made on a larger scale.

(ii) *Cultivation experiments on paddy crop.*—Different methods of cultivation as to sowing and planting now in general use all over the Valley will be compared till some definite results are obtained.

(iii) *Manurial Experiments.*—Manurial experiments with wheat, mustard and oats will be continued. The manures to be tried in each case are those which are easily obtainable by the cultivators of the Valley. Leguminous crops were also tried as a green manuring for wheat and paddy in comparison with Farm Yard manure. The object was to see whether green manuring could quite as well and economically serve the purpose of Farm Yard manure; but, on account of the heavy rains, the results being prejudicial, the experiments will be repeated.

(iv) *Rotations.*—The experiments with Norfolk rotation of four course system, *two-year* rotations and *Dofasli* rotatons will continue on the same lines as last year.

(v) *Miscellaneous Crops.*—Trial of the following crops will continue: *Juar, Bajri*, Lucerne Mangels, etc., Fibre experiments with Jute, Sunn hemp and Russian linseed on a small scale, in case some pure seed could be procured, will be tried again.

(vi) *Improved Agricultural implements.*—Some suitable Agricultural implements are under trial on the Pratap Model Farm. Their use is demonstrated to the Zemindars at fairs and on various other occasions. Some of them are decidedly superior to, and more useful than, the ordinary village implements used for the same purpose. The trials with these implements will continue for another year before deciding as to which of these can profitably be introduced among the cultivators.

II. *Seed selection and distribution of ordinary crops* will continue.

III. *Cattle-breeding.*—Efforts to improve local breeds of cattle by the distribution of stock from the Farm will be continued.

IV. *Agricultural Show.*—An Agricultural Show, which was held at Srinagar during the second week of October 1909, met with considerable success. It has been decided that one Show on a larger scale will be held every year in future.

V. The organisation work of the Department will continue.

VI. Introduction of European Fruits and Vegetables in the State Gardens will continue.

The Board accepts the Programme of Kashmir.

10.—BARODA.

Programme of the Department of Agriculture.

(M. A. Sitole, B.A., M.R.A.C. Bar-at-Law.)

There are four Farms in the State. Baroda and Kadi Farms serve as demonstration stations and as Central Depôts from which seeds, good bulls and improved machinery can be obtained. Songhad and Vyara Farms are newly established for the purpose of introducing sericulture in the country. The experimental work on which the Department will be engaged during the year 1910-11 will fall under the following heads :—

I.—Varietal experiments with tobacco, paddy, cotton, ground-nuts, potatoes, sugarcane, and wheat will be continued as last year.

II.—Manurial experiments with tobacco, sugarcane, cotton, ground-nuts and wheat will be continued as last year.

III.—Improved implements.—Suitable foreign and native implements are being introduced. Various implements demonstrated at the Baroda Farm and the local fairs are in considerable demand.

IV.—Publication of a quarterly magazine in vernacular will be continued.

V.—Insect and Fungoid Diseases will be noted and specimens collected and forwarded for examination and identification.

VI.—Sericulture.—Ericulture is being taken up in Gujarat. Efforts will be made to extend this industry.

VII.—Distribution of seed.—Collection and distribution of seed through agencies of seed-depôts will be continued.

The Board, after some discussion, agreed to the retention of the paragraph J of the report of the Committee (B), (Appendix B, page 49), referring to the sale of seed to cultivators as serving to place on record the results of experience in other Provinces.

The Board accepts the Programme of Baroda.

11.—MYSORE.

PROGRAMME OF THE DEPARTMENT OF AGRICULTURE.

(L. C. Coleman, Ph.D.)

Experimental Farm.

Manurial, rotational and seasonal experiments with sugarcane, paddy and *ragi* indicated in the programme for last year are being continued. Of these, the ones with paddy especially promise already to yield interesting and valuable results. In addition to the above, the following may be noted :—

(1) *Experiments with ragi.*—An early maturing variety of *ragi* is being tried with the object of following it by a green manure crop the same year.

(2) The sub-surface packer will be utilized for the preservation of moisture in *ragi* fields.

(3) A system of sowing the rows wider apart so as to facilitate interculti-vation will also be tried.

Paddy.—A trial of growing the nursery on the dry system will be made. It has been found that especially in a season of heavy rainfall the seeds germinate better and the seedlings grow more rapidly when sown dry than when sown in puddled soil.

Sugarcane.—A trial will be made of watering sugarcane by the ridge and furrow method so as to prevent caking.

Potatoes.—This crop is usually planted in rows one foot apart and the sets about 6 inches apart in the row. Practically no hilling is done and the irrigation water is run along the rows. This method of planting is being compared with (*a*) planting the rows 30 inches apart and the sets 9 inches apart in the rows with hilling by means of the plough and (*b*) planting as in (*a*) but without hilling.

Introduction of new varieties.—Six varieties of sugarcane, about 30 varieties of paddy and 8 varieties of potatoes are already being grown in a small way. In addition, 11 varieties of maize and three varieties of dry land lucerne have been obtained and will be sown shortly. The land available for this work is very limited, so that a comparison is made difficult and growth of seed for distribution is impossible. A proposal has therefore been made to Government to increase the area of the Farm by 20 acres (10 acres wet land and 10 acres dry land). This land, if acquired, will be utilized for variety experiments and as a small seed farm.

Sugar and jagg ry making.—Demonstrations of improved methods of jaggery and sugar making were held on the Farm in May 1909 and at the Dasara Exhibition in October 1909 and attracted considerable attention. An improved system of boiling-pans has proved especially useful and a small demand for sugar centrifugals and boiling pans has arisen. This demonstration work will be continued through the present year.

Further experiments in liming and a trial of sulphuring the juice will also be made.

A bulletin on sugarcane growing and jaggery and sugar making is in preparation.

Farm implements.—A decided increase in the demand for improved farm implements is noticeable. This applies especially to ploughs, chaff-cutters, threshing machines and bullock-gears. Two chain-pumps have been obtained from the Central Provinces and their working is being demonstrated. A demand for them has already arisen and arrangements are being made for their manufacture and distribution.

Machinery depôt.—A proposal has been made to Government with regard to the establishment of a machinery depôt and it is hoped to have this established before the end of the year.

Demonstrations of the working of improved agricultural machinery are being carried out throughout the State and this work will form an important feature throughout the year.

Agricultural training.—Arrangements are being made to give elementary training in practical agricultural operations to the sons of raiyats and land-holders on the Experimental Farm. The need for this is particularly great in Mysore, as there is no Agricultural College and it is practically impossible to send more than one or two students a year to other parts of India for training.

Chemical Laboratory.

Two of the Assistants have been sent abroad, one to England to be trained in Agriculture and one to Germany to be trained in Agricultural Chemistry. The work in the Chemical Laboratory will, in consequence, be restricted.

The experiments on soil moisture and green manures and on the utilization of bonemeal, planned by Dr. Lehmann, are being continued.

Soil survey.—A beginning has been made on the analysis of typical soils of the State and this will be continued as time will permit during the year.

Green manures.—Considerable analytical work has been done on these, and the results will be published soon in the form of a short bulletin. A short bulletin has already been published on certain " manurial earths " in use among the raiyats.

The work on the nitrifying and the free-living nitrogen-fixing organisms is being continued in conjunction with the Mycological Laboratory and it is hoped to publish some of the results before the end of the year.

Sugar and other analyses especially in connection with the work on the Experimental Farm are being carried out.

MYCOLOGICAL LABORATORY.

Ring disease of potatoes.—During the past year a bulletin was published on the ring disease of potatoes. The work on the subject is being continued and a more extensive publication on the subject will be made before the end of the year.

Koleroga of supari.—This disease has been the subject of extensive investigation during the past year. The life-history of the fungus causing the disease has been worked out and extensive experiments with regard to combating it have been made. The results are at present being prepared for press. The investigations will be continued throughout the present year.

Anaberoga of supari.—The investigations on this disease have been at a standstill but will again be taken up and will form an important item in the programme of work for this year.

Spike disease of sandal.—A preliminary anatomical study of this disease has been made. The investigation will be pushed during the present year.

Investigations of a minor nature being carried on are those on a disease of the betel vine, a disease of gingelly and the Tikka disease of ground-nut.

Demonstration and lecture work.—Demonstrations on methods of combating plant diseases, especially that of Koleroga, will be carried out. Illustrated popular lectures in the vernacular on these subjects are being prepared and are at present being given in the affected districts. It is proposed to follow all investigation work by such lectures and demonstrations.

Herbarium collection.—The work on the collection of fungi will be continued as far as time will permit. Arrangements have been made with European specialists for the naming of specimens.

ENTOMOLOGICAL LABORATORY.

Grasshopper pests.—The rice grasshopper, which does a great deal of damage in the western part of the State, is being studied. Much rearing work has already been done and facts as to oviposition, etc., have been gathered. During this year efforts will be made to combat the pest by (*a*) ploughing the bunds where eggs are chiefly laid, (*b*) catching the grasshopper by means of the bag and other similar contrivances. Another grasshopper pest which appears to do considerable damage to *cholum* (*Andropogon Sorghum*) is also being studied.

Hairy caterpillars.—The investigation of these pests is being continued; the area over which the damage extends has been roughly mapped out, and during the coming season, experiments with different combative measures will be carried out.

Insects affecting stored grains.—The study of these pests has been begun and will be continued during the dry season, when more time will be available for this work.

Demonstrations and lectures.—These are being arranged on the same general plan as for Mycological subjects and will be carried out as far as possible this year.

Insect collection.—Considerable work has been done in this direction and the collection already contains about 1,200 species. As much time as possible is being given to gathering life-history data, and a small insectary has been fitted up for this purpose. Arrangements are being made with European and American authorities for the naming of the collection.

Dr. Coleman agreed with the opinion expressed by the Committee. With the substitution of the word " and " for the words " or without " in the concluding

sentence of the report, the Board agreed that the report of the committee should stand, with the addition of the remarks made by members as recorded in the minutes.

). The Board accepts the programme of Mysore.

SUBJECT IV.—The Most Economical Use of the Manures that are Available in India.

1. The President considered that the committee's report* gave incomplete information and proposed that a committee should be appointed to deal with and report on this subject at the next meeting of the Board. Mr. Coventry explained the difficulties which had presented themselves in considering this matter, owing to divergence of opinions and lack of complete information as to previous experience of the use of the various manures available.

Mr. Clouston emphasized the importance of preparing a note collating the experience already gained in the use of manures, and Dr. Mann stated his opinion that the experience gained in one province might be of great value to workers in other provinces, although the conditions in each might be widely different.

2. Mr. Noël-Paton proposed and Mr. Clouston seconded that every province should prepare a full nete on the manures available and on the experience acquired in their use, and that these reports should be forwarded within six months to an officer to be appointed by the Inspector General of Agriculture in India, for collation and arrangement in time for submission to the next Board.

The proposal was accepted by the Board.

SUBJECT V.—The "Reh" Problem.

The report of committee (C) was read by the President and considered (Appendix C, page 51).

Mr. Renouf commented on the lack of scientific data in reports of previous experiments and emphasized the necessity of co-operation with Agricultural Chemists in dealing with this question.

He also pointed out the necessity for carefully avoiding interference with existing drainage channels, and the desirability of obtaining the co-operation of canal officers, in any future discussion of the subject of 'reh' by the Board.

Referring to the report of the United Provinces, the President enquired what was meant by the expression "large numbers of empirical experiments", and Mr. Burt explained that this referred to those made since 1874 which were badly carried out and produced records of little value. Mr. Burt, in reply to a further question by the President, explained that the enclosing of areas under grass had not produced any permanent improvement in the grazing of *usar* land. In the course of further discussion Dr. Leather pointed out the necessity for taking into account the various factors influencing the movements of soil water in *usar* lands, as without full knowledge on this point, large sums of money might be expended without adequate return. Mr. Henderson was of opinion that much might be done by utilising previous experience without employing further scientific research.

Mr. Wood drew attention to the value of the use of particular crops in improving *usar* land, and proposed the addition of a paragraph drawing attention to this method.

Mr. Couchman agreed with Mr. Wood and thought further scientific experiment might delay reclamation by methods already proved of value. He then proposed and Mr. Wood seconded that the following be inserted at the end of paragraph 13 of the report of committee (C), page 52.

"They would urge that due attention should be paid to the subsequent cropping of the land with special reference to suitable systems of cultivation and crops."

This proposal was accepted by the Board.

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* This report is not published in these proceedings.

Mr. Renouf proposed to alter the last sentence of paragraph 14, (page 52) of the Report to read as follows :—

" A full knowledge of these conditions is wanting at the present time, and the committee consequently urge the desirability of reclamation experiments being accompanied by suitable scientific investigation when possible."

This was seconded by Mr. Barnes and was accepted by the Board.

The report of the committee was then accepted by the Board with the alterations proposed.

SUBJECT VI.—THE BEST MEANS OF SUPPLYING IMPROVED AGRICULTURAL IMPLEMENTS TO CULTIVATORS.

The Report of the committee (D) was considered (Appendix D, page 53).

Mr. Noël-Paton stated that a note had been received dealing with this subject in Eastern Bengal and Assam ; this should be inserted in the proceedings of the Board (Appendix D, page 55). The Board discussed the report of the committee and accepted the suggestion of Mr. Buchan to substitute the expression "affording facilities for " for the word " inducing " in paragraph IV, page 56.

Mr. Noël-Paton suggested the substitution of the words " work towards a system under which these would be charged " for the word " charge," in line 3, paragraph I, page 56, and the insertion of the words " for some time " after the word " remain " in paragraph IV, page 56. These suggestions were accepted by the Board.

After some discussion as to the prices to be charged for implements it was agreed that Mr. Noël-Paton's suggested alteration of Recommendation No. 1 would adequately convey the feeling of the Board. The Board accepted the Report with the alterations noted.

SUBJECT VII.—THE OIL-PRESSING INDUSTRY IN INDIA AND THE BEST MEANS OF EXTENDING IT.

After some discussion on the subject of the disposal of oil-cakes, Mr. Noël-Paton put forward a proposal in the following terms :—

" That every province should prepare a note on what is being done and could be done for the popularisation of the use of oil-cakes for several purposes ; that these notes should be forwarded within six months to the Reporter on Economic Products to the Government of India, and should, by him, be collated and prepared for submission to the Board next year. "

The proposal was accepted by the Board.

SUBJECT VIII.—CATTLE-BREEDING AND VALUE OF CATTLE SHOWS IN INDIA (A NOTE BY MAJOR A. S. TRYDELL, I.C.V.D., SUPERINTENDENT, CIVIL VETERINARY DEPARTMENT, SIND, BALUCHISTAN AND RAJPUTANA)—(APPENDIX E, PAGE 58).

This subject was referred to a general meeting of the Board for opinion.

The President in introducing this subject stated that his object was to obtain free discussion by the Board, not for the purpose of passing a resolution, but of eliciting the opinions of members with a view to referring the question to a committee for preparation of a note dealing fully therewith.

Such discussion should bring out the scope of work in each province and the possibilities of co-operation with the Civil Veterinary Department.

Mr. Keatinge said that some of the difficulties of the case were pointed out in Mr. Moreland's note on the cattle conference at Lucknow, which indicated the necessity of ascertaining the local requirements of cultivators who required assistance in providing and maintaining sufficient cattle to plough their land. In some localities the difficulties of ploughing stiff cotton soils had driven cultivation on to lighter and poorer ones, and the problem, therefore, might be more properly considered a purely economic one of general farming practice. There is a strong body of opinion all over India that the Agricultural Department should not concern

itself either with the credit of the cultivator or with his cattle, and this view is held by some Local Governments and will be accepted elsewhere unless this Board recognises and puts up a strong opinion to the contrary. The Bombay Agricultural Department combines with the Civil Veterinary Department in the establishment of farms for bull breeding, and the latter buy up breeding bulls at fairs, but this method takes no cognizance of the most important factor in the case, namely, the supply of fodder, which should take precedence of the question of breeding. Examination of statistics showing the heavy losses of cattle in famine years, much of which might have been avoided by proper conservation of fodder, demonstrated the prime importance of this side of the case, and this was further emphasized by consideration of the violent fluctuations in the price of fodder. It is, therefore, evident that the question of cattle-breeding is not one which can be left to be dealt with by the Civil Veterinary Department alone, but must be considered in conjunction with the proper maintenance of cattle, and as dual control is inadvisable, the Civil Veterinary Department cannot efficiently undertake cattle-breeding in its proper sense.

Mr. Renouf pointed out that the question of cattle-breeding had been undertaken by the Civil Veterinary Department before the Agricultural Department came into existence. He said that the Civil Veterinary Department could not adequately deal with the supply of fodder, but, on the other hand, the Agricultural Department had not done much to improve this supply. He deprecated the discussion of the subject except in conjunction with the Civil Veterinary Department and thought that no report should be made upon it until this had been done.

Mr. Hemingway agreed with this view.

The President stated that he did not desire that a resolution dealing with the subject should be passed by the Board, but only that a note should be obtained from a special committee.

Mr. Hemingway was of opinion that it would be inadvisable for the Board to advocate any specific policy in this matter, especially as the great variety of conditions in various districts makes due consideration necessary before any decision can be arrived at.

Mr. Wood stated that in the Deccan districts of Madras, the cultivators have no difficulties as to supplies of fodder; young stock is bought from outside sources and paid for by annual instalments. Fodder supplies are sometimes laid by sufficient for three years' provision; where fodder is scarce, a resolution of the Madras Government allows a supply of free water for growing fodder crops after harvesting the paddy. The selection of indigenous grasses for fodder might form a worthy subject of enquiry for the Agricultural Department.

The Hon'ble Mr. Hoare indicated some of the conditions affecting cattle-breeding and keeping in the United Provinces and agreed with Mr. Hemingway that at present the success of the former depended largely on the Civil Veterinary Department.

Mr. Hemingway pointed out that co-operation with the Forest Officers was desirable in dealing with the question of baled forest fodder which was liable to be wasted by remaining unsold.

Mr. Keatinge pointed out the undesirability of duplicating the functions of the Civil Veterinary Department and of the Agricultural Department; one man could more efficiently deal with the breeding of cattle and the supply of fodder.

Mr. Renouf saw no reason why there should not be a division of labour.

The President pointed out that in this case it would involve two separate departments.

The Hon'ble Mr. Hoare commented on the fact that the Civil Veterinary Department had got into very close touch with the cultivators on account of the introduction of serum for rinderpest, and this view was endorsed by Mr. Hemingway from personal experience.

Mr. Couchman said that in his opinion the question was whether anything could be done in this matter without special consideration and knowledge of local conditions. He suggested that all local departments should be asked to furnish reports as to whether anything could be done to improve breeding. He thought it doubtful whether any action by Government could effect an alteration of the

existing state of supply and demand. He, therefore, suggested that all provincial departments be asked to report to the Inspector General of Agriculture in India how far any practical steps can be taken by the Agricultural and Civil Veterinary Departments to encourage cattle-breeding and the provision and economical storage of better fodder.

Mr. Renouf stated that in his opinion the subject of cattle-breeding did not come within the province of the Board, and he should not, therefore, consider himself at liberty to report to the Board upon it; so far as provision of fodder is concerned he would be glad to report.

Mr. Hemingway considered this the most important subject dealt with by the department, but at the same time did not think it was one which could properly be dealt with by the Board. He suggested that the questions of the breeding and management of cattle, the provision of fodder and cognate matters are of such pre-eminent importance that a strong committee should be formed to consider work done and advise on the matter before next meeting. The formation of this committee is clearly outside the province of this Board as it must deal with subjects that in some provinces affect other departments. It is suggested that the Inspector General of Agriculture in India should place the matter before the Government of India and recommend the formation of an official committee for the purpose.

Mr. Milligan said that it was a question of expediency demanding due consideration of local conditions, but, in his opinion, it was impossible to separate the question of breeding from that of fodder supply. The former is closely connected with the management of breeding farms which depend for their success upon strict personal supervision and continuity of policy. The appointment of a special official in each province to deal with this subject would ensure this.

Mr. Clouston thought the question had been considered too much from the point of view of dual control. In his opinion, cattle could be improved by better supplies of food, the inferiority of cattle in certain districts being directly due to the absence or scarcity of suitable fodder. It was, therefore, a matter to be dealt with by the Agricultural Department, and some steps in this direction had already been made and might, with advantage, be continued. The storing of surplus fodder and, perhaps, the use of silage would help to avoid loss in famine years. Coarse grasses cut before flowering could be stored as silage. Egyptian clover and wild lucerne had been successfully grown as green fodder near Nagpur. He wished to emphasise the necessity for continuity of policy in cattle-breeding and personal knowledge of local conditions.

Mr. Knight was of opinion that in undertaking the improvement of cattle in any district, special consideration should be given to existing breeds and to fodder supply; in connection with the former, the improvement of existing breeds in any locality depends upon a determination of the factors which have made them particularly suitable for their own district. Investigations in the neighbourhood of Poona have demonstrated the possibility of successful treatment of the question from an economic standpoint.

Cattle Shows.—The President invited the opinion of members of the Board on the utility of cattle shows.

Mr. Milligan thought that the necessary spirit of emulation was wanting in India, and that shows were consequently not as a rule successful; the money spent in promoting them might be more advantageously applied in other directions.

Mr. Clouston agreed that the competitive spirit was absent, but would not condemn cattle shows on that account, so long as they afforded a possible chance of improving the breed.

Mr. Hemingway was of opinion that the failure of cattle shows was due to the small number held; exhibits should be classed in accordance with the standing of the exhibitors and not by the class of cattle shown.

The Hon'ble Mr. Hoare said that the success of cattle shows depended on the possibility of sale of cattle and not on prizes given. Mr. Wood concurred with this view.

Other members pointed out that the causes which contributed to make cattle shows successful in England were not found in India.

SUBJECT IX.—CO-OPERATION BETWEEN THE EDUCATIONAL AND AGRICULTURAL DEPARTMENTS WITH REFERENCE TO THE IMPROVEMENT OF THE PRELIMINARY TRAINING OF BOYS LIKELY ULTIMATELY TO ENTER AGRICULTURAL COLLEGES OR TO BE ENGAGED IN AGRICULTURAL PURSUITS.

The report of the committee (G) was considered (Appendix F, page 65).

In the course of discussion of the report several members expressed their opinion that students for agricultural colleges should preferably be taken from the agricultural classes.

With reference to the exercise of advisory power by the Directors of Public Instruction, it was suggested by Mr. Dobbs that the word "some" should be substituted for the word "each" in line 1, paragraph 3 of the report. This suggestion was adopted.

Several members referred to the difficulty of obtaining suitable teachers, and the low scale of pay was mentioned as contributing to this condition.

The report was passed by the Board.

SUBJECT X.—THE BEST MEANS OF BRINGING THE RESULTS OF EXPERIMENTAL WORK IN AGRICULTURE TO THE NOTICE OF CULTIVATORS.

The report of the committee (E) on this subject was considered (Appendix G, page 68).

Dr. Mann was of opinion that the report of this committee would be a record which would be useful to various provinces, however widely their local conditions might differ. Advance had been made in local demonstrations of great value in backward tracts. It was of vital importance that the itinerant assistants should be of the highest type, as incalculable harm might be done by inefficient men. Close supervision of their work was, however, always essential. The annual appearance of a similar note would be of great value.

Mr. Clouston suggested an alteration in paragraph 27 of the report (lines 1 and 6). The words "the *malguzars'* class attached to the Nagpur Agricultural College" should be substituted for "Nagpur Agricultural School" and further the words "accommodation is now being provided for 12 boys" should be read for "a small hostel is now being built to hold 12."

The report was passed by the Board with the alterations suggested.

SUBJECT XI.—AGRICULTURAL ENGINEERING PARTICULARLY IN REGARD TO WELL-BORING AND WELL-IRRIGATION. PROGRESS MADE IN AGRICULTURAL ENGINEERING IN THE DIFFERENT PROVINCES AND THE NECESSITY FOR THE SERVICES OF AGRICULTURAL ENGINEERS.

The report of the committee (D) on this subject was considered (Appendix H, page 73). A considerable amount of discussion took place as to the advisability of appointing agricultural engineers, and the qualifications desirable for such work.

Mr. Couchman did not consider such appointment desirable, unless they were mechanical rather than civil engineers.

Mr. Keatinge thought agricultural engineers of great value to the department, especially when oil or steam engines were to be utilised for water lifting.

Various members were of opinion that private firms would be able and willing to provide experts to deal with machinery obtained from them. The Hon'ble Mr. Hoare pointed out that such experts were not able as a rule to devote sufficient time to particular localities, whereas a permanent engineer would be able to study local requirements.

Mr. Couchman proposed and Mr. Clouston seconded the insertion of the word "mechanical" after the word "trained" in Resolution (1) of the report of the Committee. This was accepted.

The Report was passed by the Board with the modification mentioned above. 60.

SUBJECT XII.—THE STYLE IN WHICH THE PROGRAMMES OF THE PROVINCIAL AGRICULTURAL DEPARTMENTS SHOULD BE SUBMITTED TO THE BOARD. (PAGE 38 OF THE PROCEEDINGS OF THE 5TH MEETING OF THE BOARD OF AGRICULTURE IN INDIA, 1909.)

The report of the committee (A) on this subject was considered (Appendix I, page 80). 61.

Mr. Couchman explained that the committee had come to the conclusion that the programmes were not generally expressed in terms sufficiently concise and clear for general discussion and administrative work, being hampered by excess of detail.

Mr. Keatinge was of the opinion that the suggestions of the committee would lead to unnecessary duplication of work, as sufficient information of the general nature suggested was already provided in the various reports prepared for the use of experts and of the public, and that the form taken by the Programme of the Bombay Department for 1910 was in his opinion unnecessarily full.

Dr. Mann suggested that only two or three programmes should be considered each year.

Mr. Couchman pointed out that any such restriction as that suggested by Dr. Mann would not be in accordance with the original constitution of the Board.

Mr. Howard suggested that the programmes should include sections drawn up by each Director or Deputy Director with references to detailed reports, and Mr. Warth pointed out that intelligent criticism was impossible in the absence of complete details of experimental work. Mr. Clouston deprecated this introduction of unnecessary detail which rendered the task of criticism impossible in the short time available.

Mr. Wood suggested that the preliminary circulation of an abstract would allow of obtaining the necessary details for subsequent discussion, and Mr. Evans made a proposal in the same sense which was supported by Mr. Burt.

The Hon'ble Mr. Hoare proposed and Dr. Leather seconded an amendment 62
to paragraph 2, that after the word "may" the words "if he so desires" be inserted: this was put to the meeting and carried.

The report of the committee (A) with the Hon'ble Mr. Hoare's amendment 63
was then put to the meeting and passed.

Mr. Burt proposed and Mr. Evans seconded that the provincial programmes 64
should be submitted in time for them to reach provincial officers by December, and that the committee to discuss them should be formed at the same time.

This would enable members of the committee to consult detailed reports and come to the Board prepared for adequate discussion. Attention should be devoted to the discussion of work in progress rather than to the criticism of programmes.

Mr. Renouf proposed and Mr. Couchman seconded that in the opinion 65
of the Board, it will now be sufficient if, in future, meetings of the Board of Agriculture are held in every alternate year instead of annually. Dr. Leather opposed the motion on the ground that a real advantage was gained by the opportunities afforded by the meetings of the Board for interchange of opinion.

The proposal was put to the meeting and carried. 66

APPENDIX—A.

REPORT OF COMMITTEE (A).

SUBJECT II.—PROGRAMMES OF WORK OF THE IMPERIAL DEPARTMENT OF AGRICULTURE.

1. *Programme of the Imperial Cotton Specialist.*—To avoid the risk of discrepant advice being given, the committee recommend that the words " or even by individual cultivators " at the end of paragraph 1, may be omitted.

2. *Programmes of the Imperial Agricultural Chemist, Economic Botanist Mycologist, Entomologist and Bacteriologist and Director of the Institute.*—The committee approve of the programmes with the following remarks :—

(*a*) The committee recommend that the imperial officers should ascertain from each provincial department of agriculture once a year, preferably in the month of November, if the provincial departments have any problems which they would like to be taken up for investigation.

(*b*) The officers of the Imperial Department of Agriculture should, from time to time, offer suggestions to the provincial departments in regard to their work.

(*c*) The committee suggest that in view of the promising nature of *eri*-silk cultivation, all the provincial departments which are in a position to do so should, in consultation with Mr. Lefroy, conduct experiments with a view to ascertaining whether *eri*-silk cultivation is likely to pay in the various provinces.

APPENDIX—B.

REPORT OF COMMITTEE (B).

SUBJECT III.—THE PROGRAMMES OF WORK OF THE PROVINCIAL AND NATIVE STATES DEPARTMENTS OF AGRICULTURE.

1. The proposals made by Mr. Burkill in his letter of 15th February, 1909, (*vide* page 49) were discussed, and it was resolved that it is best to leave it to the initiative of individual officers to take the opportunity afforded by the biennial meeting of the Board of Agriculture at Pusa to discuss with the officers of other provincial departments particular problems which are being taken up by several departments at the same time, so as to effect some correlation in the work; and that in this way such correlation will certainly be obtained without any special action on the part of the Board.

2. *General.*—Before discussing the details of the several programmes, the committee expressed its opinion that in several cases the programmes contained irrelevant matter dealing with departmental detail; and moreover were presented in a form which, at the last Board meeting, was considered unsuitable. In view of the fact that a separate committee had been appointed to consider the form of the programmes, this committee decided to exclude such matters from its consideration. In the consideration of several matters, the committee stated its view that in order to form a definite opinion of the work of departments it was necessary to go beyond the programmes and to supplement the information contained therein by reference to departmental reports. This is unavoidable with the present form of programme, which is only a brief sketch of the work in progress.

3. *Consideration of Departmental Programmes*:—

A. *Bengal.*—Paddy experiments are conducted on a number of farms in Bengal. The conditions of these farms differ widely, particularly in regard to soil, rainfall and irrigation. The scheme of experiments is similar in each case. After enquiry into the facts of the case the Committee resolved that it was desirable that schemes should be devised so as to vary in close accordance with local conditions. Mr. Lefroy expressed his opinion that the tussar work at Chaibassa should be discontinued, because the influence of wild males, which was unavoidable, resulted in cross breeds of unknown value, and led to disease; and said that to distribute seed from such a source was harmful.

The last sentence of the programme of the Principal should run—

"The watering of crops will be specially observed on tour in connection with well-irrigation."

The rest of the programme of Bengal was accepted.

B. *United Provinces.*—The programme of the United Provinces was accepted.

C. *Punjab.*—The locality of the second agricultural station referred to by the Deputy Director should be stated.

Notice was taken of the small amount of research work in the programme of the Agricultural Chemist. It was explained that the Agricultural Chemist is also Principal of the College, and that he considers it essential at this stage to give very special attention to the training of his assistants and of students who may join the staff of the department.

In item VI of the programme of the Professor of Agriculture, either the nature of the work referred to should be explained, or the item should be omitted.

With regard to the following items in the programme of the Economic Botanist, *viz.*, silk, lac and honey bees, Mr. Lefroy expressed his opinion that it was not advisable even to commence work on these matters, until a teaching assistant was available to assist the Assistant Professor of Entomology with the teaching work. The rest of the programme is accepted.

D. *Bombay.*—Paragraph 1 and the preceding lines in the programme of the Deputy Director, the final paragraph in his programme and the tables attached to his programme should be deleted as unnecessary. The committee considers

that the programme of the Economic Botanist is too exhaustive, and that he should be requested to submit a fresh programme confining it to such matters as he can take up at once, to be submitted to the Board. The committee considers that the work of the Agricultural Chemist cannot be ascertained either from his programme or by reference to any previous programme; and that he should be asked to draw up a programme for submission to the Board along with this committee's report.

The rest of the programme is accepted.

E. *Madras.*—The programme of Madras is accepted.

F. *Central Provinces.*—The programme of the Central Provinces is accepted.

G. *Burma.*—The programme of Burma is accepted.

H. *Eastern Bengal and Assam.*—The programme of Eastern Bengal and Assam is accepted; but the committee is of opinion that it cannot be carried through if the present staff of experts is reduced, as is understood to be proposed.

I. *Kashmir.*—The programme is accepted.

J. *Baroda.*—After enquiry into the nature of the distribution of seed practised, the committee is of opinion that it is essential to charge cultivators more for selected seed than they would have to pay for bazar grain, in order to induce them to save for themselves good seed from the grain so grown, and not to return to the Government store for fresh seed every year.

The programme is accepted.

K. *Mysore.*—The programme is accepted as suitable; but the committee is of opinion that it requires a strong staff of experts to carry it through; and that this cannot be done without the addition to the existing staff of experts thoroughly trained in Botany and Agriculture, or without the enlargement of the experimental area.

Copy of a demi-official letter, dated the 15th February, 1909, from I. H. Burkill, Esq., M.A., Reporter on Economic Products to the Government of India, to J. Mollison, Esq., M.R.A.C., Inspector General of Agriculture in India.

In reading through the provincial programmes, it has struck me that a committee of the Board might do useful work at our meeting by an endeavour to collate the work of the various provincial departments on certain of the principal crops of India. According to these programmes, the five Indian crops most widely under experiment are rice, jute, cotton, wheat and sugarcane. Cotton and wheat are already engaging the attention of imperial experts; while jute is in the hands of an officer, who, while not imperial, is authorised to advise provinces other than his own; it is on the other two crops—rice and sugarcane—that I think the proposed committee could advantageously report.

2. Rice is stated to be under experiment in Bengal, Bombay, Madras, the Central Provinces, Burma, Mysore, Baroda and Kashmir. Bengal reports that it has in hand manurial experiments, varietal selection, experiments on the number of seedlings to be transplanted together and rotation experiments. Bombay report that attention as regards rice is almost entirely concerned with the practice of *rab*-burning. Madras has experiments on manuring and on the amount of water demanded by the crop. The Central Provinces programme seems to cover almost the whole ground of the experiments of Bengal and Madras. Eastern Bengal proposes manurial experiments and varietal selection and breeding. Burma has in hand manurial experiments, rotation experiments, transplanting experiments and a study of varieties. Mysore has cultural experiments with manuring. Baroda gives insufficient details; and lastly Kashmir has cultural experiments.

3. I think that good results in so large a subject are likely to be arrived at sooner if the programmes of the various provinces are mutually fully understood and harmonised; and I recommend that a committee representing the departments interested should be appointed to meet now and to report to this or the next annual meeting of the Board, unless the subject can be equally efficiently brought before the committee on provincial programmes.

4. *As regards sugarcane*, the United Provinces, the Punjab, Bombay, Madras Eastern Bengal, Mysore and Baroda propose experiments. It is unnecessary for me to detail how they differ, the argument for concerted action in regard to this crop being the same as in regard to rice.

5. In view of the vast importance of these crops and the difficulty of gathering from the separate programmes, the exact work being done on them in each province, it appears further that it would be of great advantage if a statement could be submitted annually so long as the committee lasts, showing in detail the work being done on these crops throughout India. This, I think, would facilitate criticism and do a great deal towards rounding off the work.

APPENDIX—C.

REPORT OF COMMITTEE (C).

SUBJECT V.—The "Reh" Problem.

In framing their opinion on *the first point of reference*, the committee conclude that the reports submitted by the various provinces are, in some cases, too bulky and detailed for direct submission to the Board of Agriculture and propose to attach a brief resumé of each, as an appendix to the committee's report.

2. The report of each province has been considered in detail.

3. Starting with the problem in Bombay, it appears to the committee that the development of salt lands in the Bombay Presidency is of a special character and results from the re-action of saline irrigation water on the black cotton soil of the Deccan. The committee consider that sufficient information has not yet been obtained of the nature of this change and would recommend that experiments be pushed forward with the object of elucidating this problem before any method of cure can be proposed. At the same time, they would advise the trial of an improved system of dry cropping on such soils, as being likely to lead to more immediate relief, and worthy of consideration as a temporary measure wherever these saline wells are a cause of great distress.

4. With regard to such special cases as the Nira canal area it appears from the Bombay report that wherever the salinity of the soil of this area is not so great as to bring into play the peculiar properties of the black cotton soil above referred to—the land can be brought under cultivation again by irrigation and drainage, and the committee would, therefore, recommend that such drainage be cautiously extended where economically possible.

5. *Sind.*—The committee endorse the experiments at present being carried out in Sind under Mr. Henderson and consider they will prove to be of great value, but regret the absence of a complete chemical record of the character and quantity of the salts removed by the treatment. At the completion of this reclamation work a detailed report showing the capital and recurring expenditure incurred in the above scheme should prove of value for circulation in the Provinces interested in this problem.

6. *Madras.*—The *reh* problem in Madras presents no special features, irrigation and leaching of the salts proving satisfactory in the larger affected areas. The committee support the opinion of the Madras Agricultural Chemist that this problem is of minor importance in the Presidency.

7. *Punjab.*—From the vast area affected, the committee consider that this problem is one of primary importance in the Punjab. The cause of the accumulation of salt in the soil of these plains appears to be the excessive weathering to which it is subject by the wide ranges of temperature—combined with a slight rainfall and a lack of well-defined drainage. The most important feature at present seems to be its persistence and even re-appearance in canal irrigated areas, and the committee endorse the local department's proposals to confine its investigations to the problem as it exists in the Chenab colony, and recommend the institution of irrigation and drainage experiments as soon as the Agricultural Chemist is in a position to co-operate from the laboratory.

8. Emphasis is laid on the necessity of obtaining information on the lateral as well as perpendicular movement of dissolved salt in the soil as likely to throw considerable light on the appearance of *reh* in land under irrigation.

9. The committee also endorse the proposition to examine the economic possibilities of utilising the extracted salts for the production of substances of economic value.

10. *United Provinces.*—In the United Provinces the problem presents a somewhat different aspect to most other *usar* lands in India, in that the greater portion of the affected area contains sodium carbonate, forming the so-called black alkali soils which are commonly impervious to water.

11. In Mr. Burt's memorandum this point is emphasised together with the fact that a large number of empirical experiments have been carried out there during the past 30 years without any marked success, and this is attributed in great measure to the absence of the requisite accompanying scientific investigations.

12. The committee also approve of the suggestion that work in the immediate future would be more profitably directed to the cure of alkali in cultivated lands than to the worst classes of *usar* soils.

The examination of the results of previous work, and the Committee's recommendations for the immediate future. (Second point of reference),

13. A consideration of the various methods of removing the saline constituents from *usar* soils with the object of rendering them fit for cultivation has led the committee to the conclusion that previous work in India, owing to the lack of scientific data, does not place them in a position to diagnose each particular case and indicate the remedies to be applied. The mode of dealing effectively with the evil must depend on the particular characteristics in each case. In many cases, irrigation combined with drainage and suitable agricultural treatment will give the desired result.

14. The committee recognise that the problem is an economic one and would advise that this aspect be kept strictly in view in attacking it. It appears to the committee that a systematic endeavour should be made to obtain a thorough knowledge of the conditions regulating the accumulation and removal of saline matter. A full knowledge of these conditions is wanting at the present time and the committee consequently advise that all reclamation experiments should be accompanied by suitable scientific investigation.

15. The committee have been much impressed with the fact that some irrigation schemes have been carried out in the past without due consideration to drainage. They understand that this matter is now receiving attention, but they consider that this aspect of the case cannot be emphasised too strongly in dealing with new schemes and in remodelling canal systems.

APPENDIX—D.

REPORT OF COMMITTEE (D).

SUBJECT VI.—THE BEST MEANS OF SUPPLYING IMPROVED AGRICULTURAL IMPLEMENTS TO CULTIVATORS.

The committee first heard brief statements by members regarding the methods at present observed in the several provinces. They are summarised below.

2. *Punjab.*—The Agricultural Department receives from Government a permanent advance of Rs. 4,000 for the purpose of introducing agricultural implements to cultivators. The implements chiefly introduced are ploughs, chaff-cutters, winnowers, bullock hoes and reapers. No threshing machines have so far been purchased. Private firms have now undertaken some of the work. Their share in the business is increasing and is likely to increase. It already amounts to about ten times as much business as the share of the departmental depôt. When an order is received at the departmental depôt for any implement which a firm can supply and which is not at the moment stocked at the depôt, that order is passed on to the firm in question. It has now come to be a question whether it will long be necessary to maintain the departmental depôt. Firms sell only such implements as are approved by the Department. At present cultivators usually specify the firms to which they wish their order sent. Although no difficulty has yet arisen regarding the preferential placing of orders with one firm or another, it may well arise in the future, and it is foreseen that provision will probably have to be made against it. When the Department supplies an implement it charges a small profit of about ten per cent. over and above cost and charges. The Department holds, at Lyallpur, monthly classes of instruction in the use of agricultural implements. It also arranges for local demonstrations at fairs and other centres. The firm that sells the implements sends out notices in advance advising purchasers of implements to attend for instruction; and the Department also notifies where demonstrations are to be held so that possible purchasers may judge for themselves. One private firm stocks implements to the value of about Rs. 40,000, and last year did a turn over of about Rs. 12,000 mostly in reapers. It is expected that in this year it will do business of about half a lakh again mostly in reapers. The Department has prepared a statement showing such data (as to power and size of oxen, etc.) as might be of use to makers of agricultural implements for India.

3. *United Provinces.*—The Department has a permanent advance of Rs. 28,000 for seed and implements. Over Rs. 25,000 is devoted to the purchase, holding and distribution of implements. Some are made wholly or in part in India. Implements bought by cultivators pass through the hands of the agricultural engineer and are distributed through depôts and Deputy Directors. There are depôts at Cawnpore and Partabgarh. Payment is made by the cultivator direct to the Department. Demonstrations are held at local fairs and are notified in advance by the authority arranging the fair. Special demonstrations are also arranged at the request of zemindars. The principal implements sold by the Department are low lift chain pumps, ploughs, chaff-cutters, grain crushers, harrows and cultivators. Reapers and winnowers which have been hitherto stocked by the Department at Cawnpore are now supplied by a private firm, but little business has been done so far. A statement has been prepared showing data for the guidance of manufacturers of agricultural machinery. This was prepared for the Allahabad Exhibition and has been published in the home trade papers The Department sells at a small profit and without including interest, insurance and storage charges. It gives no credit and confines itself to business for cash and on the hire system.

4. *Central Provinces.*—In the Central Provinces so far no private firm has appeared to assist the Department. It has depôts at Nagpur, Raipur, Hoshangabad and on a small scale at Akola. The permanent advance in these provinces is Rs. 10,000. The Department stocks winnowers, ploughs, chain-pumps, sugarcane mills, maize shellers and bullock-gears. Chaff-cutters also are stocked, but as yet there has been little demand for them. Small iron sugarcane mills are, however, in some demand.

Winnowers have sprung into great demand within the last two years. A Winnower on the same principle as the American machine, but adapted to suit local conditions is manufactured by the Rasulia workshops, Hoshangabad, and in addition to this firm four other local persons have begun to make these machines in Jubbulpore and Hoshangabad districts. Every machine made at Rasulia is tested by an officer of the Department before issue, and two of the local firms have also applied to have their machines tested, as the people know the value of such preliminary testing. These winnowers have been demonstrated at fairs, and last season when heavy rain in the hot weather retarded winnowing by hand, three assistants were sent out with winnowing machines to demonstrate in certain centres in three different districts. The consequence was a sudden demand for winnowers which the Department was unable to comply with. Since last June 120 machines have already been sold, as cultivators seem determined to purchase their machines in plenty of time this season, in case the supply again runs short during the harvesting season.

2. With regard to the price—winnowers are sold at a price for which it pays the local producers to manufacture. Imported machines are sold at cost price *plus* railway freight, and as the machines are only ordered in small lots the discount is slight. This refers to the Hoshangabad depôt only.

3. No system of payment by instalment is allowed, but cultivators can apply to the district officers for a *takkavi* loan for the purchase of improved machines and implements, and a list of improved machines and implements is sent by the Deputy Director of Agriculture, Northern Circle, to all Deputy Commissioners in his circle for note and guidance. *Takkavi* is given for the same purpose in the Southern Circle also.

5. *Bombay.*—There are three agencies for the demonstration and distribution of implements—(1) Agricultural Department, (2) Firms (3) the more advanced Agricultural Associations. The Department co-operates with the two latter. The Department takes charge of machines belonging to firms and sells them without making any charge for agency. No liability is accepted by the Department for the state of implements in their charge. The Department is at present prepared to act as sub-agent for any firm that cares to enter into business. The chief descriptions of implements distributed are ploughs, chain-pumps, chaff-cutters and iron cane-mills. In Sind, there is a workshop at Mirpurkhas making ploughs, threshing machines (Egyptian pattern), water-lifting apparatus, and levelling-scrapers. This workshop made about 500 ploughs in 18 months. The farms act as depôts. The terms are cash—credit is not usually given by the Department, but a sum of Rs. 5,000 is provided for *tagai* to enable cultivators to purchase implements. Demonstrations are held at fairs or when any other opportunity presents itself, and implements are sometimes lent to cultivators for trial. It may be said that there are two or three demonstrations every month excepting in the rains; and when cultivators come in to buy seed the opportunity is taken to hold additional demonstrations. An itinerant demonstrator accompanies the Revenue Officers or Irrigation Officers and explains the use of implements in particular districts, as for instance, threshers in the Tapti valley. More orders are received by the Department than it can execute. A native firm in Belgaum has entered the trade and sells about 200 ploughs a year. The Department itself probably sells about 100. Imported implements are sometimes bought through a firm in India and sometimes direct from the manufacturers. The Department charges bare cost price, but when it receives an order that could be executed by the firm, it passes it on to that firm.

6. *Bengal.*—There is one central depôt for seed and manures. Orders were formerly executed by this depôt, but at present they are too numerous to be dealt with departmentally. A firm in Calcutta has undertaken the manufacture of ploughs which form the mainstay of the business. Other firms are ready to enter in competition. No system of inspection by the Department before delivery of implements by firms to purchasers has been arranged. There is a budget grant of Rs. 15,000 devoted to the upkeep of the central seed and implement store. The principal implements distributed by the Department are ploughs, water-lifting appliance (*dons*), sugarcane mills, evaporating pans, chaff-cutters and maize hullers. The value of the stock held is not great. Experimental farms act to some extent as depôts, but the implements there held are used only for show

and demonstration work and are not sold. No duplicates are stocked. Orders received at the farms are passed on to firms. Demonstrations are held chiefly at fairs, but also at farms in connection with meetings of divisional agricultural associations. No regular demonstration independent of such associations has so far been attempted, except in cases where the cultivator comes for the express purpose of seeing the work of an implement. There are farms for this purpose at six places in Bengal. Payment is made by the cultivator or association direct to firms supplying implements. The Department does not concern itself with the terms of payment. No statement has yet been prepared giving data for the guidance of manufacturers of implements. It has been found that there is need for local depôts or other local agencies of distribution, but the department desires that associations should be led or constrained to form such depôts independently. One such association has already done so.

7. *Madras*.—Work in this connection has been wholly confined to supplying implements of local manufacture.

The method adopted can be summed up in a few words. Lend implements free, give advice and instruction free, teach ryots how to handle these implements, until they realise that it pays them to use such. The loan of implements can then be withdrawn, and if it is really to the ryot's advantage he will arrange to supply himself with what is required either buying from the agricultural station or getting the local blacksmith and carpenter to make.

As an instance in one village near the Koilpatti Agricultural Station, in 1907, one ryot cultivated his cotton as recommended by the Department with implements and assistance from the agricultural station. In 1908, this man and his brothers and several other men similarly got assistance, though this was mainly confined to the loan of implements as several ryots had learnt how to handle these. About 300 acres were that year sown and cultivated in that way. After the season was over, the manager of the agricultural station went to the village, held an informal meeting of the ryots, told them that our work was extending to other villages, and that he could not lend them implements any more, that the village carpenter knew how to make them having worked for the Department, and that they would have to make their own. He would still give them advice and some assistance. In 1909 fifteen sets of implements were made by the ryots of this village, and 600 acres of cotton were cultivated with them.

Wherever this work of improving the cultivation of cotton is extending, the Department makes a point of having the implements required in that tract made at some centre there by the local artisans. If necessary, a carpenter used to the work is sent down for a few days to put the local men into the way of it. Thus when the Department withdraws its assistance by lending implements there will always be local carpenters who understand how to make what is required.

Mr. Lonsdale, Agricultural Expert to the Court of Wards, can explain the method he has adopted at Sivagiri for the introduction of iron ploughs where the same principle of employing local talent in the manufacture has been adopted.

In the Kurnool district, the manager of the Nandyal Agricultural Station has arranged for demonstrations of the heavy cotton soil plough. At Koil-kuntla, a plot of land infested with deep-rooted weeds has been brought under cultivation in the first season by this means, at a cost very much less than by any other means known to the cultivators. Several orders for this plough, which costs about Rs. 70 and is made by a Madras engineering firm, have been obtained by this means. Spare parts are stocked at the Nandyal Agricultural Station by arrangements with the manufacturers, so that those who buy the ploughs may not be inconvenienced by the delay involved in procuring them from Madras.

8. *Burma*.—Not represented.

9. *Eastern Bengal and Assam*.—Very little has so far been done by this Department in the way of supplying improved agricultural implements. There is no permanent advance for this purpose, and no co-operative society has yet been formed with this object in view.

A European firm in Kushtia manufactures sugar mills and shallow boiling-pans which they hire out to sugar cane growers. They have established depôts all over the Rajshahi Division and parts of the Dacca Division, from which the mills

and pans are let out to cultivators. They employ trained *mistris* at these depôts to look after and repair the mills whenever necessary. The Department also receives occasional applications for advice regarding sugar mills, and in these cases the applicants are referred to firms which deal in them.

On the Shillong Farm a small number of spraying pumps and grafting and pruning tools are stocked for sale or hire to Khasi cultivators.

Beyond this nothing has been done towards supplying improved agricultural implements and machinery except that attempts are being made to bring certain implements to the notice of cultivators by means of demonstrations at agricultural shows, and also by means of leaflets. The implements specially recommended are :—

Hindustan ploughs.

Planet Junior Hoes.

Three Roller Iron Sugar Mills.

Shallow boiling pans.

Spraying pumps (chiefly for spraying potatoes in the Khasi Hills).

Grafting and pruning tools.

RECOMMENDATIONS.

I. The first question to which the committee addressed itself was one of principle, whether the Department should introduce implements at the lowest possible cost without providing profit, or whether it should charge such profit as would leave a margin to any private firm that might elect to enter the business and relieve the Department of the work. The committee unanimously agreed that the second policy is to be preferred.

II. The committee further lays it down that in its opinion the supply of implements should not be regarded as permanently forming a part of the Department's functions.

III. On the subject of the mechanism of distribution the committee recognises that for the present the Agricultural Departments in most of the provinces must be prepared to stock implements, but they consider that every effort should be made to get firms to enter the business and to take over that part of it which relates to central depôts and the holding of stocks.

V. It is believed that for some considerable time the Department must be prepared to interest itself in the introduction of implements, firstly, by demonstration and instruction work, and secondly, by inducing co-operative societies and agricultural associations to undertake the duty of local retail. The Department must in this way remain to some extent intermediary between these associations which collect orders and the firms which execute them.

V. It is desirable that the Department should continue to own a certain number of appliances for demonstration purposes.

VI. Departments should continue to accept orders for specified firms, but cultivators should be given the option of stating clearly to which firm their orders should be given.

VII. Departmental officers should not accept and transmit orders for appliances other than those of the types approved by the Department.

VIII. Lists of approved types should be prepared by each local Department.

IX. Every local Department should prepare a statement of data likely to be of use to the manufacturers of mechanical implements suitable for the particular tract concerned.

X. The committee considered that the price charged by the Department should include not only freight, interest, insurance, depreciation and storage charges, but should also provide a suitable charge for profit, and when the implement is disposed of at an outlying place it should include a suitable percentage for carrying out the functions of a local sub-agency.

XI. It is further recommended that every effort should be directed to bringing about an arrangement under which the work of local or sub-agency distribution should be undertaken by co-operative societies, agricultural associations and similar bodies, and that it be a recommendation to such bodies that the importance of providing for the local execution of repairs and for the training of local workmen in executing them should be borne in mind.

XII. In conclusion the committee recommend that the Departments should arrange to keep themselves informed of the purchase of any agricultural machinery by cultivators, to get into touch with the purchasers, and to afford them facilities for training in the handling and care of the implements.

APPENDIX—E.

SUBJECT (VIII.)

Letter No. 100-111, dated the 5th May 1909, from Major A. S. Trydell, Superintendent, Civil Veterinary Department, Sind, Baluchistan and Rajputana, to the Commissioner in Sind.

In continuation of my reports upon the cattle shows held in Sind during 1907-08 and 1908-09, I have the honour to attach a paper which treats of the value of (*i*) shows as a means of stimulating cattle-breeding in the Province, (*ii*) the distribution of bulls for a similar purpose, and (*iii*) the general condition of cattle in Sind. The favour of early submission to the Bombay Government with any comments you may feel disposed to offer thereon is solicited.

2. My object has been to express an opinion on a subject which does not appear to have been properly discussed in my circle, so I hope now that the questions in the note will be fully considered, as, if they are, I shall feel that a beginning will have been made to try and find out what would be the most feasible and practical steps to adopt in order to bring about a general improvement in cattle, which the institution of shows desires, but which I consider they (the shows), of themselves alone, fail to do.

3. I trust that Collectors and Deputy Commissioners and others will be so good as to aid me by offering their criticism on the paper and remarking upon such points as complaints made by the people on shortage of plough and cart oxen and milch cattle (where shortage may occur) and to state what the cause of this is chiefly due to, as—excessive exportation, the occurrence of fatal epidemics and starvation.

4. Copies of the note have been forwarded to Baluchistan and Rajputana for the reason there are several points in it which apply to these Provinces which have raised questions on the subject of the improvement of stock.

A Note (i) on the question of the value of shows in general, (ii) a reference to the value of supplying bulls, and (iii) the general condition of Sind cattle by Major A. S. Trydell.*

An opinion regarding shows in general as an aid to foster breeding in India.

With reference to (*i*)—As a general idea appears to prevail amongst European officials in India that shows and the distribution of prizes at fairs materially help to effect an improvement in the breeding of all stock, I wish to offer my opinion which does not altogether coincide with these views, whilst Major Maxwell, I.C.V.D. (who was in veterinary charge of this Circle for many years), has said that it is doubtful if they afford any encouragement at all.

Describing that a show in conjunction with a fair does not combine.

2. I may start by briefly stating that ordinarily speaking a show and a fair do not combine very well. A comparison with any of the horse or cattle shows, and horse or cattle fairs in the United Kingdom may convey my meaning, as many of us have attended some or other of them. Sales and deals go on at both and prizes (often in the shape of valuable cups, etc.) are keenly contested for, which are awarded at the former for the sake of encouraging the farming and breeding communities to maintain and improve the stock in a country where breeding has been brought up to a standard as near perfection as possible, and where the general conditions for doing so are favourable. Amongst the farmers and breeders there are considerable numbers who pay the closest atten-

* I exclude horse shows conducted under the auspices of the Army Remount Department which is an entirely different matter, as they and horse-breeding are organised and managed on certain definite lines at a necessarily large annual cost. Horse stock in India is a very minor consideration with the great agricultural population of the country, at any rate with regard to the rearing of a stamp suitable for military requirements, hence it is specially fostered in selected areas by a department whose duties lie in this one direction only.

tion to all matters in connection with them, and their skill is undisputed, whilst their operations are conducted on scientific, in conjunction with practical lines. The poorest farmer feeds his stock and does not *keep more than he can provide for.* In short, so long as favourable conditions exist, *and there is a demand* with fair prices obtainable, breeding industries will, if they do not actually flourish, be maintained, but once they are seriously menaced by the introduction of other more profitable industries, they will cease, just as certain classes of horse-breeding fell off in England to a marked degree since the invention and use of the motor car*.

An example of an Indian show held in conjunction with a fair.

3. An example of a show in India held in combination with a fair may be cited, which will give an idea that the two do not readily combine. Sonepore fair (in Bengal) is so well known, I select it. The fair is an old one, but I believe the show in connection with it is of a comparatively recent date. On two occasions (1904 and 1905) I happened to be a member of the judging committee, and I observed how few competitors there were out of the thousands of elephants, camels, cattle and horses that were present for sale and exchange. I, therefore, instituted inquiries as to the reasons for the paucity of show cattle and why the owners were reluctant to exhibit. I learnt that they did not care to waste time by being kept standing about, for perhaps hours, near the judging enclosure for the particular class their particular animals would be eligible to compete in, on *the remote chance of winning 5 or 20 rupees.* They declared that such time would be much more profitably spent in making a deal. A well-known planter in those parts (Mr. Harry Abbott) who had attended the fair with unremitting regularity for 30 odd years, and who frequently acted as a judge, agreed with me that it was a useless waste of money holding the show, and he subsequently remarked to this effect in an Indian journal. A fair can and will hold its own without pecuniary support in the way of prizes, as long as there is a demand. The day the demand begins to decline, so will the fair, and small awards will be of little avail to revive it. I will now refer to shows.

The grounds upon which shows are started.

4. We, Government, are responsible in having instituted shows with the hope that they would prove, in time, instrumental in fostering and encouraging breeding in India, and for many years their progress has been reported upon. I think it as well here to give the gist of some of these reports. Firstly, there are the shows which have been newly organized and have been run for the first time. Of them it is generally said that they augur well for next year as so many heads were present, and their condition is carefully noted upon. On the other hand if the classes have not filled, and a show cannot be considered a great success, then their slight failure is put down to its being in its infancy, or the people had not quite understood the benefits which would be likely to accrue therefrom. Secondly the reports on shows of some years standing compare the number of exhibits and their condition with the numbers and condition of former years, and if it so happens, the judges vote it has not come up to the usual standard, they write that a bad season, no rain, excessive cold and so on, are the responsible factors for the failure (occasionally shows are said to be of no value and are discontinued). With reference to the newly organized show, comments are seldom made beyond the remarks I have stated above, as there is little else which can be added; but with regard to the shows of some standing, what notes are made upon the effect they have had in improving the stock in their vicinities? Having read and written numbers, I can answer that very little is recorded on this essential point.

The organization of shows by local authorities.

5. On the question of organizing a show by the local administrations and authorities, the usual procedure is, the district officials in a district which does not already boast of an annual show, sooner or later consider the advisability of starting one within their jurisdiction: they, therefore, circulate their decision and draw up a programme which is generally submitted to the Superintendent, Civil Veterinary Department of the Province, for his approval. On each occasion this action has been followed in my present circle, and with the exception of suggesting an alteration or two, I have returned the programme "approved of" for the reason I have been but a comparatively short period in office here, and as I have only

* This falling off has been progressive; there was a drop of 12,000 horses bred in 1907, notwithstanding the horse shows and breeding societies' efforts. (I have not seen last year's figures.)

lately commenced to glean something of the tens of thousands of heads of stock, in an area perhaps greater than that of the British Isles, I did not feel that I was in a position to oppose the show or offer advice one way or the other.

However, the show is finally decided upon and opened, but if I may say so,—too frequently,—without having thoroughly inquired into certain important conditions of the neighbourhood in the direction of what are the possibilities of being able to improve its stock, and how far is this desirable and required. The questions to be gone into before fixing upon holding a show include :—

Is the extent of grazing good; that is, are the grasses and fodders of a nutritious quality and sufficient ?

Is the water-supply at least fair ?

Are the natural conditions generally favourable in the way of soil ?

Are the owners in a position to send their herds and flocks to other pastures when the home grazing is fed down, or are they able to supplement scanty and poor grazing with corn, cake, etc. ?

Do the owners make any provisions for unforeseen unfortunate events, such as exceptional scarcity brought about by a bad season ?

Is the country free from fatal epidemics ?

Is mating controlled and is any attempt made to eliminate old, worn-out and malformed animals from the herds ?

Do the people herd the young stock from the adult ?

Finally, is there a demand for any particular class of stock (draught or milch cattle) ?

If these conditions have been inquired into and are present in any given area, the probabilities are that stock there is of a good stamp and quality, and the centre, of one of the more famous breeds in the country. Although a show may possibly help to maintain and encourage the standard of cattle in such an area, I strongly incline, and have for some time inclined, to agree with Major Maxwell, who says to the following effect :—However desirable the improvement and development of cattle may be, it is doubtful if the grant and distribution of a few hundred rupees at an annual show will ever materially produce any beneficial results. Supply will only be maintained or increased by demand. Reverse the conditions I have just enumerated (or even some of them), and a show would not have the slightest effect to bring about a change.

Reasons given for stating that shows do not materially effect an improvement of cattle.

6. If fair, suitable cattle are in excess in any given area for the work or produce required of them, rewards might possibly help to bring about an advance in the type, but I think there must be a stronger stimulus in some form or other, the principal of which would be demand. We offer prizes at certain shows for a siege train and an army transport class of bullock. How many are awarded for this purpose ? An almost insignificant number, so insignificant that it could seldom be worth the *cultivator's* while to breed them specially (unless he was assured of obtaining fancy prices), and there could not be a certain guarantee of his being able to cause them to develop from calfhood up to a required standard. (It would be a different matter in certain selected breeding centres, as a *breeder* could produce a good percentage.) The nearest inducements we could offer the cultivator to make a business of producing them would be, that Government would be prepared to make a steady annual demand for them. But after all Government's demand could only go to a certain limit, and as it is, has a choice of selecting from perhaps 40 to 50,000,000 adult *zebu* bulls and bullocks. Even if there is a demand amongst the actual cultivators themselves, is it possible that a show can improve matters in areas so short of feeding that half the stock, *viz.*, females, two years old yearlings and calves are in a semi-starved state, the owners being too poor to supplement what their animals can pick up by artificial feeding, their whole object being to try and keep up the condition of working bullocks (which they must do), the cows and buffalo-cows whilst in milk ? Again take the country where there is a surplus of cattle, and the people do not want to improve them as they are able to produce animals in suffi-

cient numbers which suit their requirements admirably, and sell the balance at a fair profit, and where other products will give a better return for outlay and labour. What will a show do here?

Another point to be considered. It is well known that there are certain large areas where camel and cattle-breeding formerly flourished, and where grazing was free and ample, but they are now reported to be deteriorating and diminishing in numbers. Why? Because like the motor car, more profitable industries have sprung up and taken their place, through irrigation having brought the free areas under cultivation with the aid of canal water, whilst greater facilities are daily being offered for the transport of grain and produce, through the agency of Railway extension, better roads, and waterways. A show held in such centres must fail in its object.

7. Now, independently of the question of giving prize-money on the present scale at an ordinary show, to do any real good, a proper understanding must be arrived at as to the object of the show. Is it to encourage the production of typical milk animals, or is it to produce large weighty draught beasts, or a medium thrifty general purpose animal? This point is never properly considered, it would have to be made on the basis of a thorough survey of the cattle in any given area. A question arises, what is the Sindhi breed? I think it may be safely confined to the milch cattle about Karachi (alternative name *Moach*) which are carefully looked after and attended to. They and the *Bhagnari* cattle (to be seen 40 or 50 miles north of the Jacobabad district) are the only two breeds I have come across so far in Sind and Baluchistan. The latter is a draught breed. These offer probably the best field of work; as the owners are keen and know something of the art of breeding. In Ceylon it was found that the Sindhi-Jersey cross cow gives about twice the yield of the pure imported Sindhi. The point is that to improve an animal one way—its milk producing capacity—generally means deteriorating it in another—for draught purposes—and that the same standard would not suit the whole country.

8. It is some time since I commenced making notes and observations on the value of shows and shows held in connection with fairs, and I think I have gone into the question thoroughly, including visits into the hearts of dozens of villages, but it is only recently (in March) I received a copy of a work entitled "The Commercial Products of India" by Sir George Watt, in which the subject of cattle is included. He seems to have consulted all the available literature there is on them, and to have been entirely guided by the various reports, including one of mine. He has made a note on the holding of fairs and shows. A reference to the book will indicate that I am hardly in agreement with him on this particular subject. To quote his words, he says "Government have aided [breeding] very greatly by encouraging local fairs and cattle shows by awarding special prizes on the verdict of high expert officials who have been deputed to visit the shows for that purpose." With regard to employing "high official experts" to award prizes, I beg to point out—with all due deference to him—that this is not altogether correct. The judges at shows, oftener than not, could never pose as *experts*. I have had on my judging committees men who during their whole lives have practically never had anything to do with cattle, and do not even pretend to know anything of them. They are selected as being handy at the time, and, as a rule, the whole of the responsibility of giving the awards has devolved upon myself, a veterinary surgeon.* Latterly, however, I have taken care to obtain the services of three or four native gentlemen (of the squire class) amongst whom, there is no question about it, there are many who can be classed as experts where the conformation and points constituting a good plough or cart bullock are concerned. On these committees I take up the position as a referee, and this works very well.

Regarding the distribution of bulls as an inducement to produce better stock.

9. Sir George Watt in the same work points out that Voelcker approves of the action of Government in placing bulls in the districts, and urges that the satisfactory results attained by their distribution should be pushed until the remotest corners of the empire have been reached. I am not

* Another fairly universal idea prevails in India that because a man happens to possess veterinary qualifications it necessarily follows he must also possess the knowledge of a breeder and be able to advise upon all points in connection with every domesticated animal in the country, whereas the subject of breeding is entirely different from the work taught at a veterinary college; nor could such a comprehensive subject be included or added to a curriculum which of itself takes not less than four years to complete. Further it requires years of actual and practical experience to gain sufficient knowledge of any one or two particular classes of stock before posing as an *expert* on them. India is the *only* country in the world which employs the agency of a body of veterinary surgeons to guide Government in respect to breeding operations. It is usual to give it into the hands of an Agricultural Department.

in a position to say whether Voelcker has visited many of the corners he alludes to, but I think it is probable that he has not, nor has he gone into the subject as I have, off and on, for the past thirteen years†. In 1904 I represented to the Government of Bengal that the spasmodic efforts made by district boards and others to supply a bull here and there, and then consider they have conferred a great boon upon the people in the villages chosen for the location of these sires, was often a useless proceeding and waste of funds. I doubted if the best bulls in the world, even in large numbers, would ever make much impression in producing a higher class of stock, so long as the cows are neglected on land which does not supply sufficient fodder, and the owners of the stock are only able to afford to support their working bullocks, with a supplementary ration of grain, etc. His Honour the Lieutenant-Governor of the Province called attention to these remarks and asked those who demanded bulls to observe my advice, whilst I take it the Inspector General, Civil Veterinary Department, agreed with me as he did not offer any criticism.

Take the lower part of Sind which has a very mixed class of cattle caused by the introduction of *kachhi* blood. They are generally of good size, of all colours and type of horn, and graze on waste and fallow land. The "Thar" after the rains is the great grazing place. Each village has its own "mob" of cattle which is all grazed together, and no bull calves are castrated. They are starved or fat according to the time of the year—before or after rains.

No impression would be made by distributing bulls in a case like this.

In the middle of and towards Upper Sind the cattle are less diversified in type, but in some parts they are remarkably small. The introduction of good suitable bulls would probably leave some effect hereabouts if—what I believe to be the root of the evil—the agricultural system of the country could be eradicated, and the value of intensive cultivation and the growth and saving of good fodder catch crops could be instilled into the people; until this is brought about a great change in cattle is hardly likely.

In certain parts of Jacobabad, Sukkur and Larkana it is pitiful to witness the semi-starvation of large numbers of cows and young stock which must get worse as the hot season approaches. I have seen numbers of calves twelve months old and under, tied up from morning to night, little else than skin and bone, and stunted in growth, as all they have is a minimum of milk of the poorest quality and a supplementary ration of paddy, straw, *kadbi*, etc., and sometimes a little green meat. The fibrous nature of the dry fodders should, ordinarily speaking, prove deleterious to stomachs which are of an age and condition only fit to digest milk and light nutritious diet. Common sense should dictate that the introduction of even first class bulls hereabouts could not materially effect an improvement.

The question of what should be done to improve stock.

10. I have gone to some length to offer my opinion on the value of shows and bulls, and my reason for doing so is because it appears to me that the subject of cattle-breeding, etc., has never been discussed in Sind. As a result of this note, the question may be raised as to what should be done to improve the standard of the stock, which is the reason for the introduction of shows. I think I have shown that it is a very difficult problem, and it is one which might claim special attention at the next agricultural and veterinary conferences, especially as it affects many other parts of the country. I have already said that amongst the points which should be gone into in Sind is this:—What class of stock is it desirable to improve? For example, the bullock? He seems to me to be on an average in a very fair working condition and generally said to be suitable for the work required of him. I gauge this from my inspection of the several thousand heads seen during my tours, and it is wonderful to find such a good animal which during his calfhood has so often had a very poor time of it. That his weight and size could be increased, and his condition could still be improved upon, there is no doubt, as it is little short of marvellous how easy it is to put the indigenous cattle of India into big fat condition, if they are given a chance and the attention they deserve.

Another question. Are bullocks exported in numbers which cause a shortage likely to interfere with agricultural operations? If so, how can this be best remedied? I started my touring under the impression that exportation was causing

† I was not aware that Voelcker is an authority on cattle. I am open to correction.

a serious drain on the country, but my inquiries up to the present have elicited replies that, generally speaking, the supply is not only equal to the demand, but is in excess (which excess may, however, be small). District officials have not brought shortage to notice, as far as I am aware. Do fatal epidemics tend to shorten the supply? I have so far gathered that, although every epidemic is known in Sind, they are, taking the Province, as a whole, by no means so prevalent as to cause really serious losses, or if it happens that they do, no steps have been taken to inform me. In most localities I have visited, the cultivator declares that the chief and great trouble he has before him is the absence of grazing, and his poverty does not warrant his being able to give sufficient grain, etc., to female stock. He lays no stress upon loss from disease. In the irrigated cultivated areas in Sind, the only grazing to speak of, is over waste and fallow land and the lands recently harvested; therefore, the question of grazing, the growth and saving of fodder crops, and watering are the first matters which should claim our attention, and until this is brought about I do not see how stock can be raised to a higher standard. I, therefore, suggest that early steps be taken in consultation with the Forest, Revenue and Public Works Departments to see if things can be done to make things better; and I would also suggest that the sympathies of Mr. Mollison, as the leading expert on cattle in India, should be enlisted, and his advice asked on the whole subject.

If cows and young stock could be well provided for, a general improvement should begin to manifest itself in a generation or two, and then the question of maintaining the improvement would, comparatively speaking, be a simpler matter.

Buffalo stock.

11. I have not touched upon the buffalo, as only cows are kept in Sind, and so long as they are in milk, they are fairly well looked after. The young male is knocked on the head at an early age, or sold off (except now and then one or two are selected to rear as sires). The young females require a good deal more attention than they generally get.

12. This note is based upon my observations and inquiries in the Sukkur, Jacobabad, Larkana and Hyderabad districts and the country immediately around Karachi (about a twenty mile radius). I have also consulted the weekly season reports, in which the condition of the female and young stock is neglected.

I regret I was not able to include the two districts of Thar and Parkar and Karachi this winter, the earlier part of which I spent in the Kachhi and Sibi districts in Baluchistan, for the purpose of prosecuting inquiries concerning the "*Bhagnari* breed."

Endorsement from G. F. Keatinge, Esq., I.C.S., Director of Agriculture, Bombay Presidency, No. 125, dated the 30th July 1909.

I am very glad to have seen this report by Major Trydell. Curiously enough, I have recently been going into the same question myself as regards the Deccan and have come to practically the same conclusions as Major Trydell, *viz.* :—

(1) That breeding is essentially a job for the Agricultural and not for the Veterinary Department.

(2) That shows, unaccompanied by a carefully thought out and concerted effort, are practically of no use.

(3) That the provision of good bulls can only be effective under conditions which are anything but general in India.

(4) That the question of fodder and feeding is one that is usually neglected, but is in reality of the utmost importance.

(5) That so far as the ordinary cultivator (as opposed to the breeder, *gavli* or *rabari* of a few grazing tracts) is concerned, the common grazing ground and free pasturage are far from being a blessing, and are in fact a bar to progress.

2. So far as Sind is concerned Major Trydell's remarks in paragraph 9 are very interesting in view of the question of *barsim* growing. It is commonly objected that though *barsim* is an excellent fodder there will be little demand for it in Sind since the people already have sufficient. Major Trydell declares that in many parts the cows and young stock are regularly starved, and that supplementary fodder is a first essential for improved breeding.

3. The same is very much the case in the Deccan. Take an average Deccan village (excluding the Ghât tract where the heavy rainfall ensures an abundance of grass). During the cold weather the cows and young stock get some fair pickings of grass off the *mal* lands and the fields after the crops are removed. During the hot weather they steadily lose condition as the grass supply fails, but are just kept going, possibly by a little *kadbi* at night. When the young grass comes up with the early rains they eat it greedily and suffer greatly from scouring and indigestion, so that their condition is even worse than in the hot weather. It is only during the end of the rains and the cold weather that they get any chance of recovering. Add to this that on the common grazing grounds they are liable to catch any epidemic disease that is about, and that they are infested with ticks for most of the year, and particularly during the rains, which cause great loss in condition; and it will be realised that the parentage is not a matter of the same importance as in England where adequate food, shelter and closed pastures are the order of the day. When you have 50 fair cows for whom reasonable fodder and shelter can be provided, and who can be kept away from miscellaneous bulls and animals suffering from contagious or infectious diseases, it is of real value to provide a good bull for them; otherwise the value is very doubtful.

4. To turn to the question of fodder, the common assumption is that the cows and calves shift for themselves, and the feeding costs nothing or next to nothing. Thus a calf at one year may be worth Rs. 3, at 2 years Rs. 10, and at 4 years Rs. 30, if it has survived to that age. These values of course allow nothing for feeding, and are based on a supposition of free pasturage. This supposition is, however, most fallacious so far as most tracts are concerned, and to breed on this basis is to court failure, since the grass is the first thing to fail in a famine year. Of course in some favoured localities cattle may be reared very cheaply on the constant grass supply; but excluding these, the locality for encouraging cattle-breeding by the cultivator as part of his ordinary farm work, is the locality which habitually has an excess of *kadbi* which will enable the cattle to tide over a famine year; and the storage and economical use of such *kadbi* is a matter of great importance. The price of cattle is now rising to a point which will admit of reasonable care and food being expended on rearing; and it cannot be recognised too soon that it is a fallacy to suppose that a cultivator can rear cattle without providing food for them; and that there must be something wrong with Government if the Deccan hills do not bear an adequate supply of grass. The question of fencing and hedges for cattle is one which I have taken up. At present prices most cultivators cannot afford to buy cattle; they must, therefore, breed cattle for their own work and may make something out of the process.

5. I think that Major Trydell's note deserves considerable commendation, and I would suggest that it might be printed, and that Major Trydell and Mr. Henderson might be directed to consider the whole question of cattle-breeding in Sind, and the steps that should be taken to encourage it; the inquiry to include the following points :—

(1) The tracts suitable for breeding;

(2) The kind of cattle to be aimed at;

(3) The supply of fodder and the whole question of feeding;

(4) The rate at which cows breed and calves mature;

(5) The value of calves at different periods;

(6) The liability of infection due to common pasturage, and the best means of checking it;

so that it would be possible to form some idea of the probable profit or loss which would be involved by cattle breeding on rational lines. I have already asked Mr. Hewlett and the Agricultural officers in the Presidency proper to take up such inquiries.

APPENDIX—F.

REPORT OF COMMITTEE (G.)

SUBJECT IX.—Co-operation between Agricultural and Education Departments.

1. *Agricultural Schools for Primary Teachers.*—The Agricultural Department is at present asked to assist in finding suitable instructors to teach nature study in the training institutions for primary teachers. But it has as yet no further connection with the training schools; and its officers do not see the teaching which is given by the instructors whom the Department has recommended. The committee think that the Agricultural Department might offer its services to the Education Department to take part in supervising these courses of instruction at the training schools. In their opinion such co-operation may be of assistance in keeping these classes to the object which they are intended to perform, *viz.*, to prepare good rural teachers for primary schools, able to teach country children to observe and think about familiar objects of rural life, and able to illustrate their lessons by a properly kept school garden; and the co-operation proposed may also be of assistance in preventing these classes at the training schools from being misdirected towards the object of providing a course of instruction in agriculture or demonstrating particular agricultural improvements. The Agricultural Department might usefully confer with the Education Department as to the courses of nature study followed at the training schools, the text books used, the practical work prescribed, the provision and up-keep of a model school garden at the training school and the lessons given to the students under training; and possibly also as to the selection of the students who should undergo such training in nature study, so as to limit the teaching to those who will profit by it and be able to apply it intelligently. The Agricultural Department might be invited to send officers, from time to time, to inspect the teaching of nature study as carried on in the training schools and to report upon it.

2. *Secondary Schools.*—Courses of Agriculture are offered in a few secondary schools in some provinces and are proposed in some other provinees. The syllabus of such courses has, as a rule, been drawn up with the assistance of the Agricultural Department: the instruction is usually given without further reference to the Agricultural Department, but in one province the schools, where it is given, have been recently visited by a Board of officers of the Agricultural Department. The committee are of opinion that for the boys, who are to enter Agricultural Colleges, it is not an advantage, and most of the committee consider it a positive disadvantage that they should previously have received at school instruction in a course of agriculture. They recommend that the Agricultural and Educational Departments should confer upon the question whether these courses should be maintained as a means of providing agricultural teaching for boys who are not intended to proceed to an Agricultural College, and in the event of its being decided to retain them either in their present form or subject to modification, the committee recommend that the Agricultural Department should co-operate with the Educational Department in their supervision in the same way as has been proposed above in respect of nature study in primary training schools.

With respect to the preliminary training of the boys who are intending to enter Agricultural Colleges, the committee find that at present the chief deficiencies of the students lie in a lack of power to observe what is before them and to reason about it, an insufficient command of the English language, and also, but not universally in a want of manual dexterity not in the coarser operations of the field, but in the finer work of the laboratory. So far as these deficiencies may arise from shortcomings in the secondary schools, it would not be within the power of the Agricultural Department to offer any assistance in their removal. The requirements of the Agricultural Colleges would best be met if the students before entering them had received at school a good general education including nature study, drawing and manual training, and including also a grounding in the rudiments of some science, preferably Botany or Chemistry, taught practically. It appears possible that some assistance might be rendered by the Educational Department in bringing to the notice of the boys who appear suitable for an agricultural career, the

facilities now provided by the Agricultural Colleges for pursuing an agricultural career; and if the Educational Department are willing to do this, the committee recommend that a paper containing the necessary information about the colleges and emphasising the qualities desired in the students, should be prepared by the college authorities, to be put into the hands of the head-masters of the secondary schools.

3. *Agricultural Colleges.*—The constitution of each of the Provincial Colleges provides for the Director of Public Instruction being associated with the management in an advisory capacity; and nothing more than this would be done by rules to ensure the co-operation of the Director of Public Instruction with the Agricultural Department in college affairs. The extent to which the Director of Public Instruction actually visits the institutions and advises into their management differs in the several provinces. The committee understand that in all cases the Agricultural Department is ready to welcome the full exercise by the Directors of Public Instruction of their advisory power, so far as the other claims upon their time may permit, and would be glad if their visits to the colleges were more frequent.

4. *Formation of a Committee on Agricultural Education.*—The committee are not sure whether they are desired to express their opinion upon that part of the letter from the Government of India, dated the 29th November 1909, (see below) which relates not to the co-operation of the Departments, but to the formation of a committee of the Board of Agriculture to consider questions connected with Agricultural Education; but if so, they recommend that this proposal should be carried into effect, and they further recommend that the committee so constituted should be empowered to invite one or more officers of the Education Department to join it.

From the Secretary to the Government of India, Revenue and Agriculture Department, to the Inspector General of Agriculture in India, No. 1240—210-1, dated the 29th November 1909.

In continuation of this Department's endorsement No. 10, dated 6th July 1909, I am directed to address you in regard to the recommendation made by the Board of Agriculture at its last meeting that a permanent committee should be formed to advise on matters relating to agricultural education both at Pusa and in the provinces. The sub-committee whose report was adopted by the Board thought that there was much scope for useful work on the part of the proposed committee. It would consider the report of each Agricultural College, and the degree of success or failure attained in the different systems of education in force, and would make proposals to the Board of Agriculture as to any modification in those systems, which experience might suggest to be advisable. It was proposed that the committee should meet biennially, and that it should be composed of representatives from each college, with at least one Director of Agriculture and an educational expert who would have power to add to their number for special reasons.

2. The Government of India recognise the importance of the object which the Board of Agriculture had in view in making this recommendation, but after careful consideration they have decided that in the circumstances to which I am to refer below, they would not be justified in approving of a proposal which would probably tend to excessive centralisation. The replies which they have received from Local Governments to their Circular No. 30—28-41, dated the 18th October, 1907, regarding the proposal that some form of degree or diploma should be conferred by Provincial Agricultural Colleges indicate that there will be more co-ordination between the systems of agricultural education in the different provinces than in any other branch of education. The standard of general education qualifying for admission to Agricultural Colleges will be fairly uniform except in the case of the Bombay College, where it is slightly higher than elsewhere; the length of the course will be the same at all colleges; most Local Governments have accepted the standard curriculum drawn up by the Board of Agriculture subject to such modifications as local conditions may render necessary; and a strong agency for co-ordinating the systems is provided by the Central Agricultural College at Pusa to which picked students from the Provincial Colleges will resort. In addition, there is the Board of Agriculture representative of the Provincial

Departments of Agriculture and of the Colleges, which meets annually and which provides an opportunity for an interchange of information and opinion respecting the working of the different colleges, and of everything, including agricultural education, which affects the agricultural interest. In the circumstances the Government of India doubt whether there is any need at present for the separate committee proposed, or whether the committee could formally be *constituted consistently with the principle of provincial responsibility*. There would be no objection, however, to the Board of Agriculture's forming a committee of its members to consider questions connected with agricultural education and giving a certain degree of permanency by re-electing, if available, the same members in succeeding years and by arranging, if necessary, for their corresponding with each other, subject to any orders that Local Governments and Administrations may pass regarding the participation of officers subordinate to them. The committee, of course, would abstain from any appearance of interference in details of local management. Its object would be to give the members of the Agricultural Department the best opportunity of learning by comparison of their own policy and experience with those of officers from other provinces, how agricultural education can best be developed on lines suitable to the part of the country they have to deal with, and how the Central Institution at Pusa can best exercise its functions for the benefit of those who have already had the advantage of a training in provincial institutions.

3. The question of co-operation between the educational and agricultural authorities does not arise directly out of the recommendation of the Board of Agriculture, but I am to suggest the subject for consideration by the Board at its next *meeting with reference to the improvement of the preliminary training* of boys likely ultimately to enter Agricultural Colleges, or to be engaged in agricultural pursuits.

APPENDIX—G.

REPORT OF COMMITTEE (E.)

SUBJECT X.—THE BEST MEANS OF BRINGING THE RESULTS OF EXPERIMENTAL WORK IN AGRICULTURE TO THE NOTICE OF CULTIVATORS.

In considering the question referred to them, the committee have taken the report which was recently published and have discussed the various methods of approaching cultivators under the same headings as those there adopted.

2. *Agricultural Association.*—The development of agricultural associations has gone on during the past year, largely on similar lines to those already described especially in the Central Provinces and Bombay. In the former case, further experience would seem to indicate the advisability of making the work which the members are asked to do, more definite and on a larger scale. For instance, instead of small quantities of seed of many crops being distributed, those which are or are likely to be of importance in each tract only are usually given out, and then a quantity sufficient to sow an acre of a kind already tested and recommended. In Bombay while great development can be recorded, the methods have not been changed. Associations are spontaneously springing up in many tracts, and the difficulty is in providing the staff to give the help which they require and ask from the Department. As a new form of utility may be mentioned the utilisation of the members as seed growers under contract for the Department in Dharwar.

3. With regard to other Provinces, there is nothing to report in reference to associations beyond that contained in the former report and the present committee endorse the general conclusions on this subject contained in that report.

4. *Local Demonstrations.*—On this aspect of the subject, several new examples of success were submitted.

5. In the Central Provinces, a new scheme whereby local demonstration is facilitated in backward tracts like Chhattisgarh has been developed during the year. It is found that it is difficult for Agricultural Assistants to get into as close touch with the cultivators as is required. As a result, the best among a number of superior labourers who had been to some extent specially imported into the district to teach the transplanting of rice, have been permanently retained by the Department as *kamdars*. These were trained in the additional subjects of (1) the proper method of irrigating wheat, (2) the cultivation of ground-nut and (3) the cultivation of sugarcane, and have now been employed to actually work in the fields of cultivators demonstrating these matters throughout the year. Each works in two villages as a rule, and five of them are supervised almost daily by an Agricultural Assistant who rides from village to village and who thus is responsible for demonstrations in a group of ten villages. They are paid Rs. 9 rising to Rs. 15 and are usually able to read and write. So far the scheme has been a considerable success, enabling a large area to be dealt with at a minimum cost.

6. The committee recognise the value of this scheme and suggest it for consideration in similar backward tracts. The essence of its success lies in the constant, almost daily supervision which the Agricultural Assistant is able to give, and they consider that special attention should be drawn to this point.

7. In Bombay, considerable progress has been made in utilising the workers on the farms and local expert cultivators for demonstration purposes. This has been carried out to such an extent in connection with the improvement of jaggery (*gul*) boiling that at times there have been twenty gangs of sugar boilers employed on this business at the same time. Large numbers of other local demonstrations are made on a similar system. As in the Central Provinces, the necessity of constant supervision is recognised and a Divisional Inspector or trained agriculturist of some sort is constantly passing from place to place where such demonstrations are going on. A new line in the same direction has been the attachment of demonstrators of improved implements, by request, to the camp of certain Assistant Collectors.

8. In Madras, progress has been made both as to methods and results and the following note submitted by Mr. Sampson illustrates the directions of work and the conclusions drawn :—

> "The area under drill-sown cotton has extended this year to over 1,500 acres grown by *ryots* exclusive of seed farms. Training classes were started at various centres to train *ryots* or their labourers in handling the drill with very fair success, though the people did not put the same confidence in these as in our own men. There has been a large extension of single paddy planting in the Tanjore delta as well as in adopting a system of green manuring. Here no demonstration has actually been done, but a Farm Manager who is now on special duty in the delta has been able to get people to adopt these improved methods by referring cultivators to others in different villages who have already tried these improvements with success. In the case of green manure crops, the Department has purchased seed and sold it at cost price to people who intend to try it, and thus has overcome for the *ryots* the initial difficulty.
>
> "It is surprising, however, how slowly any good practice will sometimes spread. One village in the delta was found where it has been a practice for many years for the people to grow sunn-hemp as a green manure crop, yet the practice has never got beyond this one village. However, many are now trying it this year since the Department has taken up the matter. The work of this Manager shows how it is possible to collect and connect the local practices and institute improvements without any actual demonstration, and how this is only possible after the officer has instituted a detailed enquiry into the local practices and got to know the more intelligent and practical cultivators personally."

9. In the Punjab, among recent developments may be mentioned the institution of a monthly class on the Lyallpur Farm to learn the working of harvesting implements as recommended by the Department. Further a system of retaining men trained in the carrying out of particular operations for the purpose of demonstrating these to the cultivators has been adopted on a small scale. This is not unlike the *kamdar* system described above in dealing with the Central Provinces.

10. In the United Provinces, the methods previously employed have been actively used during the year, and progress made has been considerable.

11. In Eastern Bengal and Assam, the only new development has been the utilisation of the Dacca Farm for training several sons of cultivators with a view to demonstration.

12. In Bengal, demonstration work is being done in improved methods of making *gur* at agricultural shows and on the farms. Members of associations send gangs of cultivators specially to the farms to learn the improved methods. Beyond this, practical demonstrations are given with improved ploughs and water lifts. Such demonstrations are conducted by the senior assistants in the Department, and very large numbers of the implements worked are being adopted by the people.

13. *Village Agencies*.—There is nothing to add to the remarks under this heading in the report. The use of village shops as agents for machines recommended by the Department is still a success in the United Provinces.

14. *Vernacular Agricultural Journals*.—The progress in this direction has been chiefly in improving the journals which exist under the control of the various Departments. In the United Provinces, there has been an increase in the circulation of the departmental journal. The same has been the case in the Central Provinces, where the *Agricultural Gazette* is now illustrated and has added a veterinary section during the year. It has in a number of cases been taken up by schools. In Eastern Bengal and Assam an agricultural calendar has been issued during the year for the first time.

15. *Leaflets and Circulars*.—These have been, as previously, utilised almost in every Province. It becomes increasingly evident that they should be short and that the information should be concentrated on one definite point. As

regards distribution of the leaflets, it is felt everywhere that this can be most effectively done in connection with demonstrations. As to other methods, the committee are disposed to recommend the use, where possible, of co-operative credit societies or local agricultural associations as means of distributing them. Visitors to farms and inquirers should, of course, have copies. It is more doubtful whether a useful purpose is usually served by circulation to village officers or village schoolmasters, though in a small percentage of cases it may be advantageous.

16. *Agricultural Shows and Exhibitions.*—Very few new methods of work in connection with agricultural shows have developed during the year, but it seems clear that the most effective work can be done by a number of small shows rather than by large central exhibitions. The show or fair must, in many cases, be regarded as the means of attracting the people and the demonstrations which take place along with it as the real vital point in connection with the introduction of improvements. It has been suggested, and the committee endorse the suggestion, that probably prizes may be distributed in many cases to better effect if given for standing crops in cultivators' fields rather than only for samples exhibited in the show, and which may have been bought from the nearest shop-keeper.

17. *Itinerant Assistants.*—In Bombay, the system of itinerant assistants described in the report under review has been developed very much during the year, and in conjunction with the activity of local associations, has been the means of largely extending the cultivation of Broach cotton and securing that it should be grown by the best methods, of increasing the area under ground-nut cultivation and introducing better varieties, of bringing about improvement in *gul* boiling, of showing the people how to steep *jowar* seed against smut and securing the adoption of the method in introducing the selection of seeds, and introducing improved implements on a considerable scale. It is felt more than ever that such itinerant assistants must be among the best and most experienced men in the Department and so be able to command the respect both of the village authorities and the cultivators wherever they go.

18. In Madras, the previous system has been developed, by which the Farm Manager tours frequently in his own district and during the year one of the senior assistants in the Department has been placed on special duty in Tanjore. In this case, his primary work has been to study the agriculture of the delta to see whether it would be advisable to open an agricultural station there. As a result of his local work, however, considerable quantities of green-manure seed, for example, wild-indigo, *Tephrosia purpurea* and sunn-hemp were sent into the district and easily sold.

19. In the United Provinces it has been decided during the year to keep some special men for the work now under consideration, and they are now engaged in this direction. They are again among the best men in the Department. Little more can be said under this heading. With regard to other Provinces this is contained in the previous report.

20. The committee desires to express the opinion that the touring and demonstration work of all itinerating assistants paid by the various departments, should be closely supervised and directed by the Deputy Director in charge of the division, and that they should, on no account, be employed at all until they have had adequate training on a Government farm.

21. *Seed Farms.*—In the Central Provinces it has been decided that the areas where cultivators grow selected seed for the department, must be self-supporting. Last year the seed was sown for the cultivators by the Department: this will not be done in future, and it is felt that if the seed enters in this manner into the ordinary channels of trade at a remunerative price, good progress will have been secured. This system seems likely, for instance, to introduce comparatively quickly large quantities of *Buri* cotton (acclimatised American Upland), and selected seed of pure varieties of wheat in their separate tracts into general cultivation. In Bombay, as has already been stated under another heading, the members of the agricultural association at Dharwar, are being utilized as growers of *kumpta* cotton seed which is then bought by the Department at slightly enhanced rates for sale and distribution, and similar methods are being adopted with the best type of Broach cotton seed in northern Gujarat and Kathiawar. In Madras,

the area grown for seed cotton in Tinnevelly district has extended to 560 acres, all drill sown. The separate jute seed farms in Bengal have been given up, and seed is either produced on the general farms of the Department or bought from the best jute districts in Eastern Bengal, as it is found that the latter gives a higher quality fibre.

22. In general, the committee consider that the conclusions in this matter indicated in the last report still apply.

23. *Seed Depôts.*—In this connection Mr. Sampson of Madras Department has submitted the following note of progress:—

> "Small village depôts have proved very successful in distributing pure *karanganni* cotton seed in Tinnevelly district. There were over 30 of these this year each stocking usually 5—10 *pothies* (about 1,250—2,500 lbs. of seed), while there were a few bigger depôts where 30—40 *pothies* were stored. The man who had charge of the depôt was selected from the village; he stored the seed, parcelled and weighed it out to buyers and kept a register containing the buyers' names, amount sold, area to be sown, and amount paid, and survey numbers where available. He received 4 annas a bag or Re. 1 per 1,000 lbs. sold for his trouble. In this way 560 *pothies* (about 140,000 lbs.) of seed was sold. The great advantage in this over large depôts is that the seed is on the spot when a sowing rain comes—an important point in black soil villages where the cart tracks are impassable after rain. Only about 250 lbs. of our whole stock of seed remained unsold."

24. In other provinces progress has continued on the former lines.

25. *Utilization of Individual Expert Cultivators for the introduction of Improved Methods in New Districts.*—One instance of success in this direction can be quoted, in the introduction of men from Mymensingh to teach the steeping of jute in new districts by the Bengal Department.

26. *Training the Sons of Cultivators.*—On this very important matter several items of progress can be recorded.

27. In the Central Provinces the Nagpur Agricultural School may possibly be gradually dispersed, but in its place a number of cultivators' sons are to be taken on the farms of the Department for short courses in all the improvements which can be recommended for that tract. At present, arrangements have only been made in connection with the Raipur Farm where a few such have already been taken. A small hostel is now being built to hold 12, and they will be put under the special control of a particular member of the trained farm staff. No pressure will be used to bring them in any way, and the success of the course will be allowed to depend entirely on the value which it is found to possess; if successful, it is hoped that this will be extended as the staff becomes available.

28. In Madras, the sons of *ryots* come on to some of the farms and work as labourers in order to learn the improvements which can be taught.

29. In Bengal, there is a course for the sons of cultivators at the Cuttack farm lasting two years. The boys are called student cultivators and work regularly on the farm themselves, receiving the ordinary pay of the labourers.

30. In other provinces the matter remains much where it was before.

31. *Co-operation between Officers of the Agricultural Department and District Officers.*—Under this heading reference may be again made to the fact that in Bombay several Assistant Collectors request a fieldman to be attached to their camp when on tour to give specific demonstrations such as that of an improved plough and *gur* making to cultivators. This naturally can only be the case when a District Officer requests it, but *then* it seems likely to have much influence.

32. *Other Methods.*—Attention has been drawn to the chance of obtaining the enthusiastic co-operation of cultivators more particularly in growing good seed or a new crop, by the presentation of something for competition in a small area. In the Central Provinces, certificates are proposed to be presented for the best results obtained, and there is keen competition. In Bombay similar results are reached by the giving of prizes, generally of a honorific character such as a *pagri* under similar conditions.

33. Another suggestion worthy of consideration is that of the extent to which the buying agents of large firms can be utilised for the introduction of superior varieties of crops. A case of this sort has occurred in Tinnevelly where the representative of a particular firm undertook to buy the whole of the crop from one type of seed at slightly over the market rates. The committee feel that if such co-operation can be obtained it will be of great value.

34. A consideration of the cases which have now been cited lead the committee to believe that not only is progress being made, but also that the methods are becoming more definite, and the conditions likely to lead to success better defined. There are indications that, while the general conclusions of the report of last year's committee still hold good, entirely additional methods are being adopted, and modifications being made which represent a distinct advance on those which were before the Board at the last meeting.

APPENDIX—H.

REPORT OF COMMITTEE (D.)

SUBJECT XI.—AGRICULTURAL ENGINEERING PARTICULARLY IN REGARD TO WELL-BORING AND WELL-IRRIGATION. PROGRESS MADE IN AGRICULTURAL ENGINEERING IN THE DIFFERENT PROVINCES AND THE NECESSITY FOR THE SERVICES OF AGRICULTURAL ENGINEERS.

Notes on the progress of well-boring and well-irrigation in the several provinces were put in by members representing these provinces and were read by the Chairman. These are attached as appendices.

2. Details of the work in the several provinces were discussed at the time of the Chairman's reading these notes.

3. Discussion was then directed to the principles that issue from experience recorded, and the following resolutions were adopted :—

4. The committee read the reference as implying the appointment of an experienced engineer in each province, and consider that such an appointment is essential.

Resolved.—I. That the work of well-boring is such as calls for the technical control of a trained engineer.

II. The committee is not prepared to make any specific recommendation as to the extent to which the administrative control of the subordinate staff engaged in well-boring is to be in the hands of the engineer referred to.

III. The committee consider that the results produced by well-boring form a valuable asset of the Agricultural Department, and that, on the facts, as at present ascertained, the control of the organisation should remain in the hands of that Department.

IV. It is recognised that the work of raising water by power may develop on a scale which will render it desirable to hand the matter over to the Public Works Department, but that experimental work in this connection may well be conducted by the Agricultural Department unless the Public Works Department are prepared at once to take it up vigourously.

V. In provinces where there arise problems such as the raising of water by power from sources not under the control of the Irrigation Department, or the use of engines for purposes of the primary treatment of agricultural produce, it is essential that a trained mechanical engineer should be employed to advise.

VI. The entertainment of such a mechanical engineer in each province is of extreme importance also for the designing, constructing and improving of ordinary agricultural machinery and implements suitable for the country, and of water-lifts for hand and bullock power, and of appliances for well-boring.

MADRAS.

Note by Mr. H. C. Sampson.

5. *Agricultural Engineering.*—Irrigation is so intimately connected with agriculture that anything connected with finding water, sinking wells, means of lifting water is always looked upon by correspondents as agricultural work, and they are so far right in that it is essential that any who gives such advice should have or should be able to acquire a knowledge of agriculture.

(*a*) At present, work in connection with well-boring and installation of oil-engines and pumps is done by the Department of Industries, but this by no means covers the field of enquiry, and there is no one else to whom, at present, it is possible to refer.

(*b*) Land drainage, prevention of erosion, carrying off flood water again are points for an agricultural engineer to take up. In all black cotton soil tracts, the annual loss from these causes is very great. I have seen places where black

soil *ryots* have gone to considerable expense in building overflows, even of *pukka* masonry, but until water flows down, the man has no idea whether his outlay will do the work required of it. We are only now gaining our experience at the Koilpatty Agricultural Station in dealing with flood water and erosion on black cotton soil.

(*c*) In the manufacture of new and improving old and indigenous implements, an agricultural engineer would be particularly useful. Other officers have little time for this work, nor have they the necessary tools or skilled labour to put their ideas in effect.

For example, the bamboo seed drill is quite capable of covering its own seed, if the necessary hoes are attached to it. This would save a great amount of labour at sowing time when every moment is of vital importance.

Again some simple implement is required for lifting the ground-nut crop. I have ideas of what is required, but have not time to put them to test.

Again the bullock hoe now used is not adjustable, and this operation has to be deferred until the crop is established; in the meantime, the moisture in the soil is fast disappearing, and no more rain may fall, while if the hoe could be adjusted to do narrower work, the crop could often be saved.

(*d*) The type of man who, I consider, is wanted is a trained mechanical engineer who has had some experience in ordinary engineering. If stationed at the Central Agricultural Station, he would have ample opportunity of gaining a fair agricultural knowledge.

(*h*) The following information on the subject of well-boring in Madras prepared by Mr. C. W. E. Cotton, Acting Director of Industries, at the request of the Director of Agriculture, explains what has been done in Madras. As regards well-boring and pumping no further steps are necessary, as the Industrial Department is making good progress. I agree with Mr. Sampson that a good mechanical engineer (not a civil engineer) would be useful in several directions, but as well-boring has been provided for, there is not at present sufficient work to justify the employment of an agricultural engineer in this Presidency. Whenever any implement such as iron sugar mill, or an iron plough, is proved to be an improvement on the implements used by the cultivators the policy followed is to get it made by private firms.

Note by C. W. E. Cotton, Esq., I.C.S., Acting Director of Industries, Madras.

Towards the end of 1906 Government resolved to organise a small boring party to encourage ryots in the extension of irrigation from wells and to provide them with necessary expert advice. It was considered that a necessary preliminary to such extension was the grant of State loans for the construction of wells under the *takkavi* system. A special Duputy Collector under the immediate control of the Collector of Chingleput District was appointed with three Revenue Inspectors to assist him in the disbursement of loans, and two trained boring parties were attached to make exploratory boring and sink wells. The Sub-Overseer who was working in the pumping experiments branch of this Department was placed under the Deputy Collector in charge of the boring party on Rs. 35 per mensem, and two sets of tools capable of boring 3″ holes were provided. Two *mistris* from Pondicherry were also engaged on Rs. 35 per mensem. Operations at the outset were confined to the Ponneri *taluq* and to the construction of new wells for which State loans were to be granted on the applications of the *ryots*. Subsequently this was modified to include the improvement of existing wells. The latter method proved so very successful that there were 110 applications pending on 31st March 1907 to be complied with within the short period of six months from the commencement of the operations. A fee of Re. 1 was charged for the services of the *mistri* or Sub-Overseer, and the ryot had to arrange for carting the tools to his place and for supplying labour. In the bottom of the wells where underground springs were tapped, pipes 6″ and 7″ in diameter were put down to reach the water-bearing stratum. This so increased the capacity of the wells that in some cases the flow was found to be almost perennial, and where the ryots were rich and their holdings sufficiently large, this additional water was utilised by putting down a large number of addi-

tional *mhotes* for irrigation purposes. Twelve oil engines and pumps were also installed as the direct result of increased supplies revealed with a total *ayacut* (if the term may be used in this connection) of 112·48 acres. It was soon recognised that the improvement of old wells as a means of protection against seasons of draught was more important than the addition of new wells, and this was illustrated by diminished applications for loans and increased demands for borings.

In June 1907 Government agreed that the question of more systematic exploration with reference to a hydrographic survey should be taken up, and in pursuance of this policy Mr. Chatterton was put in charge of these operations in January 1908 and to assist him, an engineer subordinate on Rs. 150 a month, was sanctioned, and the purchase of a petrol engine and pump to test the capacity of water supply in the bore-holes was approved. The appointment of 6 *mistrics* was also sanctioned. In December 1907 operations were extended to the Tiruvallur *taluq*, where also sub-artesian supplies were discovered, and in connection with the installation of engines and pumps in the southern parts of the Presidency, a number of preliminary borings were executed to test the extent and the quantity of water supply. As indications were afforded there of the existence of large water bearing strata similar to that in Chingleput, Mr. Chatterton recommended the extension of the boring work to all other parts of the Presidency where favourable conditions prevailed. This was sanctioned by Government in February 1909.

In the beginning of the present official year a scale of fees was drawn up to be levied from *ryots* in connection with the various branches of the Pumping Department, according to which a fee of Rs. 3 is now levied at the outset for applications for borings, and up to date Rs. 694 has been remitted into the Treasury under this head, which shows the *ryots* are beginning to realise the advantage of thus improving their water-supply. The major portion of our work hitherto has been confined to sinking or improving wells in the alluvial tracts of the Chingleput District. In the Coimbatore District there is a large expanse of cultivation under wells, and as the underground springs there are met with in fissures in hard rocky strata, the method of boring suited for Chingleput could not be adapted for borings there. A small allotment was sanctioned for the purchase of a rock-bar exploder, and wells are now being improved in that district by blasting the rock with dynamite. The results of these operations in their first year of working are given in the extract (Enclosure I) from the Administration Report of the Department for 1908-1909. Quite recently a few sets of ordinary boring tools were sent to the Kistna, Tinnevelly and Godavary districts, and numerous applications for preliminary borings are pouring in. The boring staff now employed is shown in Enclosure 2, and it is found to be insufficient to keep pace with the growing demand for borings. It is, therefore, proposed to add to their number and to purchase eight more sets of tools. It is also under contemplation to purchase a keystone driller or Calyx drill worked by steam power to put down bore-holes in hard clayey tracts of the upland districts and in the rocky strata like those of the Ceded Districts and Coimbatore. A machine of the former type has been purchased by the Department on behalf of the zamindar of Davarkota, Kistna District, and the results gained from working it should have an important bearing upon the lines in which the boring work of the Department will be directed hereafter.

ENCLOSURE I.

Torpedoing operations were commenced in the Coimbatore District in May 1908 and continued till September when the rains set in. During this period 21 wells were tested—nine in the Coimbatore *taluq*, six in Tirupur, five in *Erode* and one in the Salem District. The total number of holes in which charges were put was 42, the quantity of dynamite used being $62\frac{1}{4}$ lbs. In 9 wells there was an appreciable rise in the water-supply ranging from 4″ to 5″, and in 8 no effect at all was produced. Generally speaking, the results in Tirupur were more satisfactory than in Coimbatore *taluq*. In one instance at Kadiampatti the water-supply has been doubled by torpedoing. Much, no doubt, depends on the nature of the rock from which the water-supply is derived, and much more experimental work is necessary before definite conclusions can be drawn as to the strata which afford the best chances of successful blasting. The Supervisor reports that "many

ryots could have availed themselves of the benefit of torpedoing, but by the time their bore-holes were ready the monsoon had already burst and filled the wells." There is a general willingness to have bore-holes put down by the agency of Government at the ryots' cost.

ENCLOSURE 2.

List showing distribution of boring *mistries* and boring tools throughout the Presidency.

Districts.	No. of boring *mistries* at work.	No. of set of boring tools.
Tiruvallur Section, Chingleput District	3	3
Villupuram, South Arcot and Tanjore Districts	4	4
Tinnevelly	1	1
Coimbatore	1	1
Anantapur	2	1
Vellore	1	1
Bezwada	1	1
Rajahmundry	1	1
Madras workshops	3	1
Total	17	14

Besides these the following Supervisors are employed for supervision—

8 Supervisors on Rs. 150 each.
8 Mechanics on Rs. 35 each.

6. United Provinces.

Well-boring.

	1907-08.	1908-09.	1909 (latter 6 months only).
Number of borers	53	51	50
Sites for wells tested	335	434	122
Rejected as useless	117	291	87
Wells bored for improvement	690	734	502
Substantially improved	441	479	552
Rate of boring in running feet per day employed in boring	20 feet per day in last quarter of year.	25·71	No corresponding quarter.
Expenditure	35,917	49,295	25,000

The number of well supervisors employed to supervise the borers is four.

The expenditure figures are for the financial year, whilst those of boring are for the agricultural year. Expenditure figures are exclusive of well engineer and of four well supervisors.

The agricultural engineer's services have been found very essential in improving agricultural machinery and boring implements in particular. Private firms can provide sealed pattern machinery, but the adaptation of machinery to local needs has to be done by the agricultural engineer.

Punjab.

7. *Well-boring.*—It is proposed to adopt a similar system as in the United Provinces.

(a) Sanction has been obtained for the expenditure of Rs. 10,000 on boring plant in this financial year. Ten separate plants are being purchased, and the necessary staff is under organisation.

Bengal.

8. *Well-boring.*—Well-boring was begun in Bengal at the end of 1907. An overseer of the Public Works Department was deputed to the Agricultural Department and sent to the United Provinces to make himself acquainted with the system in use there. He returned to Bengal early in 1908 and, having trained a man for boring in each of eleven districts of Behar, was appointed superintendent of well-boring. Each borer had about three months' training, and was then deputed to work where directed by the Collector of the District, the supervision of technical details being the duty of the superintendent.

(a) When some thirty borings had been made, it became evident that perhaps owing to the unusual depth to which it was necessary to bore in South Behar, the superintendent was unable to supervise the work independently. The Principal of the College at Sabour was, therefore, put in charge and went into the details of the work himself in connection with the further training of the borer. He found that such a constant exercise of judgment was required that it was unlikely that some of the borers would, with any training, become skilled while the case of the tool alone required some knowledge of fitting. In fact, an engineer's supervision was required both in selecting and training the men and to keep them up to the mark.

(b) Of the wells bored, it transpired that some had ceased to give water, and the borings were probably not always properly finished. Every boring should be inspected and the discharge tested before being passed, and this again requires an engineer.

(c) The work so far done has indicated a possibility that very large supplies of water comparable to those obtained in Madras, may be obtained from deep borings of large diameter in South Behar; the Department of Agriculture is unable to undertake such borings without expert assistance and is in fact at present employing a firm of engineers to sink a six inch boring 170 feet deep, with a view to erecting a pumping plant should the expected supply be obtained.

(d) The boring work of the Bengal Department of Agriculture must, therefore, be regarded as in an experimental stage, and the officer at present in charge of it is convinced that, while there is every prospect of success, the process cannot be made efficient without the supervision of an engineer.

(e) Mr. Moreland, who was consulted with regard to the organisation, is of opinion that it would not be practically possible to work with the District Engineers, and enquiries have shown that many of them have not, in fact, time to be of much assistance in Behar.

Note by Mr. M. H. Arnott, Superintending Engineer, P. W. Dept., Bengal.

9. *Well-boring.*—I am of opinion that the matter of well-boring is such a technical one and requires such special training that I cannot see how, if it is to be successfully carried out on any large scale, it can be worked by any one except engineers.

(a) It does not seem that members of the Agricultural Department are more fitted for doing this work than those of any other Department under Government, and I doubt if the Irrigation Department could really undertake the work with any real hopes of success unless extra engineers were drafted into it. Unless an Irrigation Engineer can give his whole time to this work, I do not see that matters will be much improved, for his time is even now with his present duties more than fully occupied.

(b) If the work is to be put under the Irrigation Department it should, in my opinion, form a special branch of it.

CENTRAL PROVINCES.

10. *Well-boring.*—A boring apparatus of the sludger type was obtained from the United Provinces but found to be unsuitable, as the areas where well sinking is most necessary are situated mostly on trap rock.

Boring for water does not promise to be of much value in these Provinces as the supply in trap rock is so uncertain. Probably the training of men to blast deep wells or deepen present shallow ones would be of more value.

If boring is undertaken, it would have to be carried out by the best type of rock boring machinery under expert supervision. Such boring is already used on various mines in the Central Provinces, and judging from the experience of *mines* it is impossible, generally speaking, to undertake trial borings in the trap country at a reasonable cost.

BOMBAY.

11. *Progress made in Boring Wells.*—Well-boring was first taken up systematically by the Bombay Agricultural Department in the spring of 1908. In May of that year, a second grade overseer of the Public Works Department was temporarily transferred to the Agricultural Department, and three *mukadams* were placed under the overseer who was placed under the directions of the Deputy Director of Agriculture.

(*a*) The boring apparatus was the common jumping bar with a chisel fixed to the bottom end, and this worked inside a pipe. When sufficient soil had been broken, the chisel was removed, and a mud shell was substituted for it and this brought up the soil to the surface. After a number of unsuccessful borings, it was decided to abandon this type of tool, and accordingly a complete plant of the apparatus used by the United Provinces Government was obtained at a price of Rs. 600. The overseer was meanwhile deputed to Cawnpore to make himself familiar with the working of this plant. Good results were soon obtained, and three complete plants were brought into working order.

(*b*) During the remaining part of that year, *viz.*, 1908 to 1909, 25 wells in all were bored, of which 15 were successful and 10 unsuccessful. A well was considered to be successful when sufficient water was added to enable an extra *kos* to be worked. A *kos* lifts roughly 1,000 gallons per hour and is worked for 8 hours per day. In some cases, very much more than 1 *kos* was added. The best results obtained showed an increase of 4 to 5 *kos*. The work has been continued in the present year (1909-10), and out of 22 wells bored, 13 have proved successful. At the present time, there are 5 complete plants of Cawnpore sets of boring tools each in charge of a *mukadam* on a pay of Rs. 12 to Rs. 15 per mensem under the boring overseer whose pay is Rs. 75—5—100 per mensem *plus* a horse allowance of Rs. 30 per mensem.

(*c*) The wells selected for boring are chosen according to the following arrangement. A list of rules and regulations has been distributed, and well masters submit their applications to have their wells bored to the local revenue officers, *viz.*, the *mamlatdars*. The boring overseer then inspects these wells, and if he considers the conditions are such as to indicate the probable success of the boring, he accepts the well but not otherwise.

(*d*) Originally we obliged the well master to deposit Rs. 100 with his application, but this was found to work badly and had to be abandoned.

(*e*) The chief terms for boring a well are :—

The Department provides the apparatus and a trained *mukadam*, while the well master and a gang of 10 coolies do the unskilled work. If the well proves a success, the Department recovers the pay of the skilled labour *plus* the cost of piping from the well master ; but if the boring proves a failure, the Department stands the loss of the skilled labour, but has the right to remove the piping.

The cost of the boring work last year, 1908-09, worked out at Rs. 1-7-0 per foot exclusive of piping which amounted to Rs. 1-4-0 per foot. This year, 1909-10 we have been able to reduce the cost of work to Re. 1 per foot for actual boring and annas 14 per foot for piping. The wells bored are usually 50 feet deep, and the maximum depth below the bottom of the well bored has been 100 feet, but the usual depth at which boring it stopped if not successful is 50 feet.

(*f*) This boring work is confined to the alluvial soils of Gujarat, and, indeed, the United Provinces apparatus is only suitable for such soils and will not work in *murum* or rocky soils.

(*g*) The experience gained up to the present time in this boring work is decidedly encouraging, because the results show that with the minimum of superior supervision, it is quite possible to conduct such work successfully by means of the staff referred to above.

(*h*) Apart from the boring work done by the Department, the Collectors of certain districts in the Deccan do boring work with the common jumper tools and in the Ahmednagar district a fair amount of success has been met with.

APPENDIX—I.

REPORT OF COMMITTEE (A.)

SUBJECT XII.—THE STYLE IN WHICH THE PROGRAMMES OF THE PROVINCIAL AGRICULTURAL DEPARTMENTS SHOULD BE SUBMITTED TO THE BOARD (*PAGE 38 OF THE PROCEEDINGS OF THE 5TH MEETING OF THE BOARD OF AGRICULTURE, 1909*).

From of Report.—The sub-committee approves of the decision arrived at by the Board of Agriculture last year that separate programmes should be prepared by the individual provincial officers in charge of each section of the work.

2. In order to focus the various lines of work and bring them together, a brief summary of the work of the province may be prepared by the Provincial Director.

3. *Distinction between Work in Progress and New Work.*—The committe feel that there is room for improvement in the provincial programmes in the direction of greater clearness. It should be possible to gather a clear idea of the work proposed for the future, as well as its relation to the work of the past from the programme itself without reference to the administrative reports of the provincial departments or the annual reports on the agricultural stations. The committee consider that each programme should contain the following information in regard to each line of work both new and old. Information as to the scope of the work (*i.e.*, its aim) the results, if any, obtained since the submission of the previous programme, and the direction in which it is proposed to continue the work during the coming year. When a new line of work is proposed, its aims and methods should be succinctly explained in a similar manner. As an illustration of what is required the committee would refer to the heading "Crops" in the programme of the Deputy Director of Agriculture, Bombay, where the *objects* of the experiments on cotton, wheat, *juar*, tobacco, etc., are succinctly given, and the methods by which it is proposed to effect those objects are outlined.

4. As an illustration of the way in which the results obtained should be indicated, the committee would refer to the sub-paras. (1) and (2) under section 6 (Palur Farm) of the Deputy Director of Agriculture, Southern Division, Madras.

5. If these suggestions were adopted, the relation of the present programme to that of last year would be clearly brought out.

6. The committee recognise the fact that the adoption of this suggestion would, in some cases, make the programmes somewhat longer than they are at present, but this disadvantage would be more than outweighed by the advantage of having a clear statement of the position of the work in each province to put before the Board, on which useful criticism could be based. A greater continuity of policy would also be secured.